Telecommunications Protection Circuits Data Book 1988

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Transient Suppressor Products

TEXAS
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Telecommunications Protection Circuits Data Book

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ISBN 0-904047-53-9

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PROTECTOR SELECTION GUIDE

SUBSCRIBER LINE INTERFACE CIRCUITS

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	TISP8180	T0220 3 wire	145 V	2-73
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Transformer Coupled SLIC Battery Backed Ringing	TISP2180	T0220 3 wire	145 V	2-17
	TISP7180	T0220 3 wire	145 V	2-69
	TISP2290	T0220 3 wire	200 V	2-17
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RING GENERATOR/LINE TEST EQUIPMENT

DESCRIPTION	DEVICE NUMBER	PACKAGE	LINE VOLTAGE	PAGE
Earth/ground Backed Ringing	TISP3180	T0220 3 wire	145 V	2-35
	TISP8180	T0220 3 wire	145 V	2-73
	TISP8290	T0220 3 wire	200 V	2-73
Battery Backed Ringing	TISP2180	T0220 3 wire	145 V	2-17
	TISP7180	T0220 3 wire	145 V	2-69
	TISP2290	T0220 3 wire	200 V	2-17
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SUBSCRIBER EQUIPMENT - 2 WIRE

DESCRIPTION	DEVICE NUMBER	PACKAGE	LINE VOLTAGE	PAGE
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	TISP4180	D0220 2 wire	145 V	2-49
	TISP5180	T092 2 wire	145 V	2-61
	TISP9180	D0220 2 wire	145 V	2-77
	TISP5290	T092 2 wire	200 V	2-65
	TISP9290	D0220 2 wire	200 V	2-77

SUBSCRIBER EQUIPMENT - 3 WIRE

DESCRIPTION	DEVICE NUMBER	PACKAGE	LINE VOLTAGE	PAGE
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	TISP3180	T0220 3 wire	145 V	2-35
	TISP7180	T0220 3 wire	145 V	2-69
	TISP8180	T0220 3 wire	145 V	2-73
	TISP2290	T0220 3 wire	200 V	2-17
	TISP7290	T0220 3 wire	200 V	2-69
	TISP8290	T0220 3 wire	200 V	2-73

INTEGRATED SERVICES DIGITAL NETWORK

DESCRIPTION	DEVICE NUMBER	PACKAGE	LINE VOLTAGE	PAGE
Inter-wire ISDN	TISP4082	D0220 2 wire	58 V	2-45
3 Wire ISDN	TISP2082	T0220 3 wire	58 V	2-13
3 Wire ISDN	TISP3082	T0220 3 wire	58 V	2-31

TRANSMISSION EQUIPMENT

DESCRIPTION	DEVICE NUMBER	PACKAGE	LINE VOLTAGE	PAGE
Repeaters/analogue Concentrators Earth/ground Backed Ringing	TISP3180	T0220 3 wire	145 V	2-35
	TISP8180	T0220 3 wire	145 V	2-73
	TISP8290	T0220 3 wire	200 V	2-73
Repeaters/analogue Concentrators Battery Backed Ringing	TISP2180	T0220 3 wire	145 V	2-17
	TISP7180	T0220 3 wire	145 V	2-69
	TISP2290	T0220 3 wire	200 V	2-17
	TISP9290	T0220 3 wire	200 V	2-69

General Information 1

Transient Suppressors 2

Appendix A

2

Transient Suppressors

TISP1082
DUAL ASYMMETRICAL TRANSIENT VOLTAGE SUPPRESSORS

NOVEMBER1986 – REVISED APRIL 1987

FOR APPLICATIONS IN
TELECOMMUNICATIONS EQUIPMENT

The TISP1082 is designed specifically for telephone line card protection against lightning and transients induced by ac power lines. These devices will suppress voltage transients between terminals A and C, B and C, and A and B.

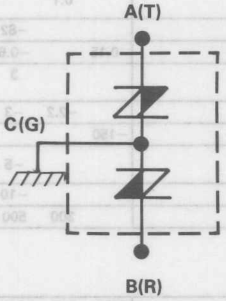
Negative transients are initially clipped by zener action until the voltage rises to the breakover level, which causes the device to crowbar. The high crowbar holding current prevents dc latchup as the transient subsides. Positive transients are clipped by diode action.

These monolithic protection devices are fabricated in ion-implanted planar structures to ensure precise and symmetrical breakover control.

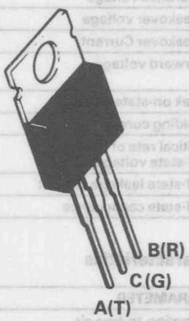
- **Breakover Voltage, $V_{(BO)}$ Max** **82 V**
- **Zener Voltage, V_Z Min** **58 V**
- **Holding Current, I_H Min** **150 mA**
- **Surge Rating:**

ANSI	**150 A**
VDE0433	**2.0 kV**
RLM88	**1.5 kV**
CCITT IX K17	**1.5 kV**

device schematic



TO–220 PACKAGE



Pin C is in electrical contact with the mounting pad.

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TISP1082
DUAL ASYMMETRICAL TRANSIENT VOLTAGE SUPPRESSORS

NOVEMBER1986 – REVISED APRIL 1987

absolute maximum rating at 25°C case temperature (unless otherwise noted)

RATING	SYMBOL		UNIT
Non-repetitive peak on-state pulse current			
8/20 µs (ANSI STD C62) (see notes 1,2)	I_{TSP}	150	A
5/210 µs (VDE0433 10/700 µs, 2kV) (see notes 1,2,3)	I_{TSP}	50	A
0.2/310 µs (RML88 0.5/700 µs, 1.5kV) (see notes 1,2,3)	I_{TSP}	38	A
5/310 µs (CCITT IX K17 10/700 µs, 1.5kV) (See notes 1,2,3)	I_{TSP}	38	A
50 Hz RMS on-state current 2.5 s (see notes 1,2)	I_{TSM}	10	A
Initial rate of rise of on-state current	di_t/dt	250	A/µs
Junction temperature	T_{jmax}	150	°C
Operating free air temperature range		0–70	°C
Storage temperature range	T_{stg}	–40 +150	°C
Lead temperature 1.5 mm from case for 10 s	T_{lead}	260	°C

NOTES:
1. Above 70°C, derate linearly to zero at 150°C case temperature.
2. This value applies when the initial case temperature is at (or below) 70°C. The surge may be repeated after the device has returned to thermal equilibrium.
3. Most PTT's quote an unloaded voltage waveform. In operation the TISP essentially shorts the generator output. The resulting loaded current waveform is specified.

electrical characteristics for the A and B terminals, $T_j = 25°C$

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_Z	Reference zener voltage	$I_Z = \pm 1$ mA	±58			V
I_D	Off-state leakage current	$V_D = \pm 50$ V			±10	µA
C_{off}	Off-state capacitance	$V_D = 0$, f = 1 kHz See note 4		1	5	pF

electrical characteristics for the A and C or the B and C terminals†, $T_j = 25°C$

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_Z	Reference zener voltage	$I_Z = -1$ mA	−58			V
α_{VZ}	Temperature coefficient of reference voltage			0.1		%/°C
$V_{(BO)}$	Breakover voltage	See Notes 5 and 6			−82	V
$I_{(BO)}$	Breakover Current	See Note 5	−0.15		−0.6	A
V_F	Forward voltage	$I_F = 5A$ See Notes 5 and 6			3	V
V_{TM}	Peak on-state voltage	$I_T = -5A$ See Notes 5 and 6		−2.2	−3	V
I_H	Holding current	See Note 5	−150			mA
dv/dt	Critical rate of rise of off-state voltage	See Note 7			−5	kV/µs
I_D	Off-state leakage current	$V_D = -50$ V			−10	µA
C_{off}	Off-state capacitance	$V_D = 0$, f= 1 kHz See Note 4		300	500	pF

thermal characteristics

	PARAMETER	MIN	TYP	MAX	UNIT
$R_{\theta JA}$	Junction-to-free air thermal resistance			62.5	°C/W

† Polarity is determined at terminal A or B with respect to C.

NOTES:
4. These capacitance measurements employ a three-terminal capacitance bridge incorporating a guard circuit. The third terminal is connected to the guard terminal of the bridge.
5. These parameters must be measured using pulse techniques, $t_w = 100$ µs, duty cycle ≤2%.
6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.
7. Linear rate of rise, maximum voltage limited to 80% V_Z (minimum).

Parameter Measurement Information

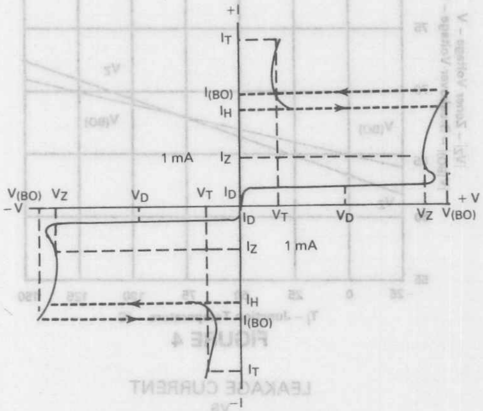


FIGURE 1.
VOLTAGE-CURRENT CHARACTERISTICS
FOR TERMINALS A AND B

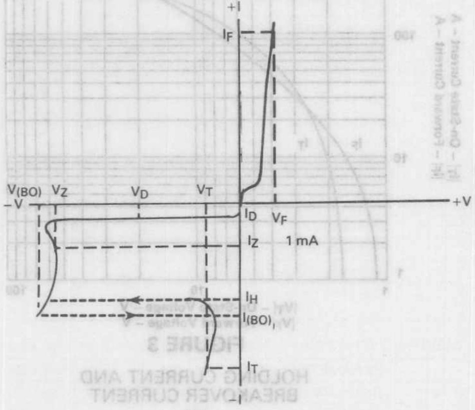


FIGURE 2.
VOLTAGE CURRENT CHARACTERISTICS
FOR TERMINALS A AND C OR B AND C†

† Polarity is determined at terminal A or B with respect to C

TYPICAL CHARACTERISTICS
for the A and C, or the B and C terminals†

ON-STATE AND FORWARD CURRENTS
vs
ON-STATE AND FORWARD VOLTAGES

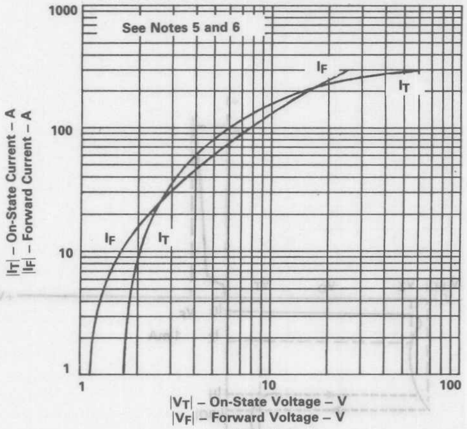


FIGURE 3

ZENER VOLTAGE AND
BREAKOVER VOLTAGE
vs
JUNCTION TEMPERATURE

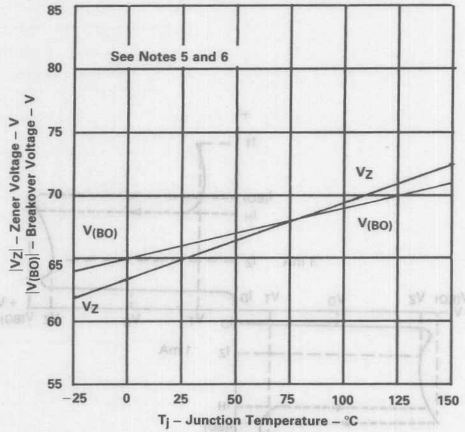


FIGURE 4

HOLDING CURRENT AND
BREAKOVER CURRENT
vs
JUNCTION TEMPERATURE

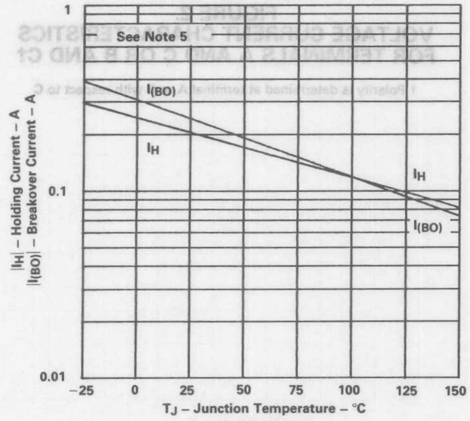


FIGURE 5

LEAKAGE CURRENT
vs
JUNCTION TEMPERATURE

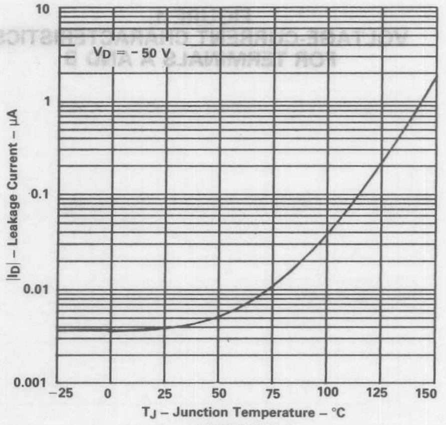


FIGURE 6

† Polarity is determined at terminals A or B with respect to C

NOTES: 5. These parameters must be measured using pulse techniques, t_w = 100 μs, duty cycle ≤2%.
6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.

TYPICAL CHARACTERISTICS
for the A and C, or the B and C terminals†

ON-STATE VOLTAGE AND
FORWARD VOLTAGE
vs
JUNCTION TEMPERATURE

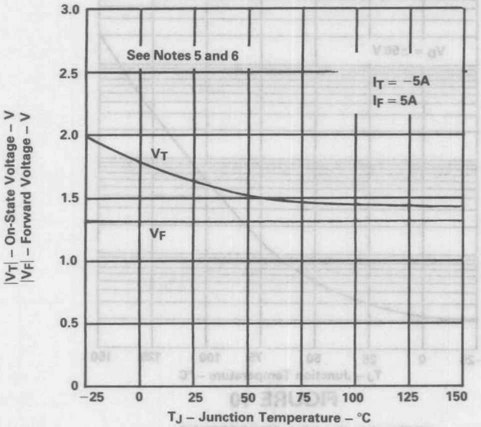


FIGURE 7

TYPICAL CHARACTERISTICS
for the A and B terminals

ZENER VOLTAGE AND
BREAKOVER VOLTAGE
vs
JUNCTION TEMPERATURE

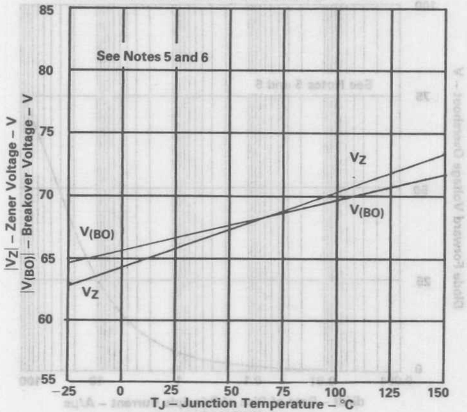


FIGURE 8

HOLDING CURRENT AND
BREAKOVER CURRENT
vs
JUNCTION TEMPERATURE

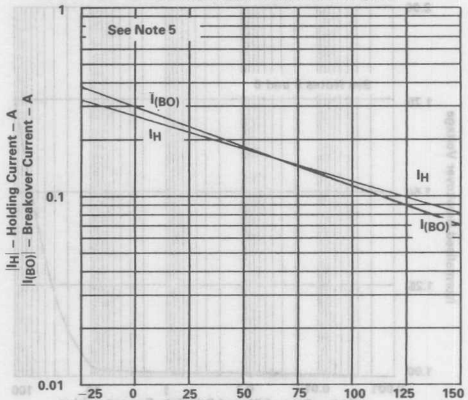


FIGURE 9

† Polarity is determined at terminal A or B with respect to C

NOTES: 5. These parameters must be measured using pulse techniques, t_w = 100 μs, duty cycle ≤2%.
6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.

TYPICAL CHARACTERISTICS
for the A and B terminals

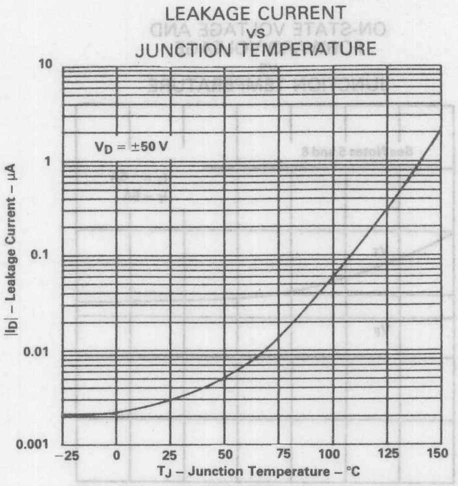

LEAKAGE CURRENT
vs
JUNCTION TEMPERATURE

FIGURE 10

TYPICAL CHARACTERISTICS
for the A and C, or the B and C terminals†

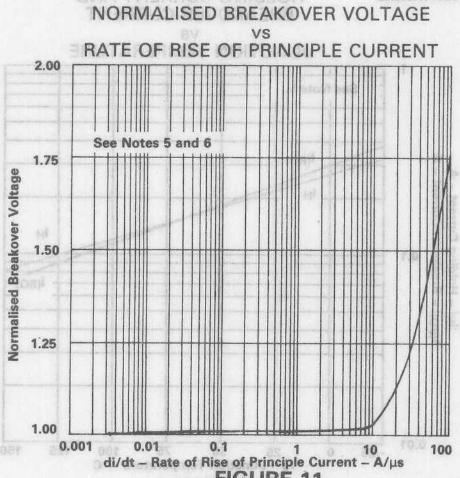

NORMALISED BREAKOVER VOLTAGE
VS
RATE OF RISE OF PRINCIPLE CURRENT

FIGURE 11

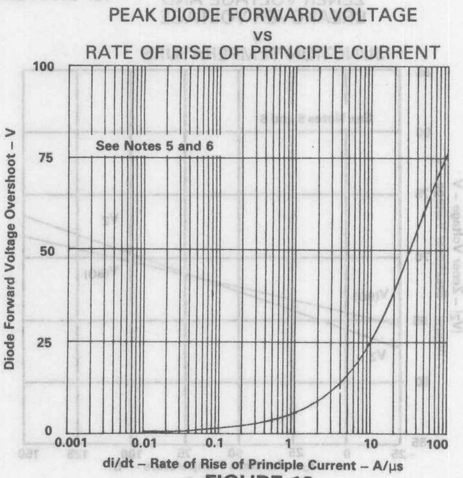

PEAK DIODE FORWARD VOLTAGE
VS
RATE OF RISE OF PRINCIPLE CURRENT

FIGURE 12

† Polarity is determined at terminal A or B with respect to C

NOTES: 5. These parameters must be measured using pulse techniques, $t_w = 100$ μs, duty cycle ≤2%.
6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.

TYPICAL CHARACTERISTICS
for the A and C, or the B and C terminals

OFF-STATE CAPACITANCE
vs
A OR B TERMINAL VOLTAGE (POSITIVE)

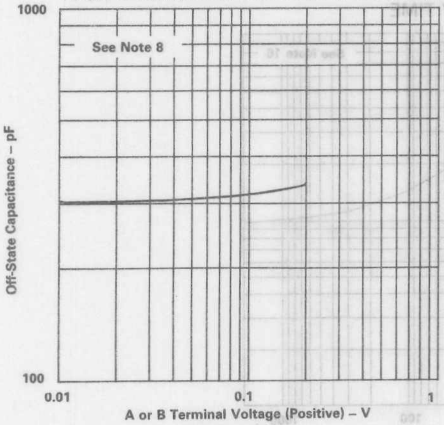


FIGURE 13

OFF-STATE CAPACITANCE
vs
A OR B TERMINAL VOLTAGE (NEGATIVE)

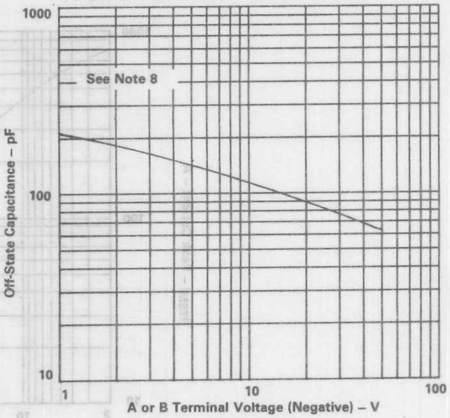


FIGURE 14

TYPICAL CHARACTERISTICS
for the A and B terminals

OFF-STATE CAPACITANCE
vs
A OR B TERMINAL VOLTAGE (POSITIVE)

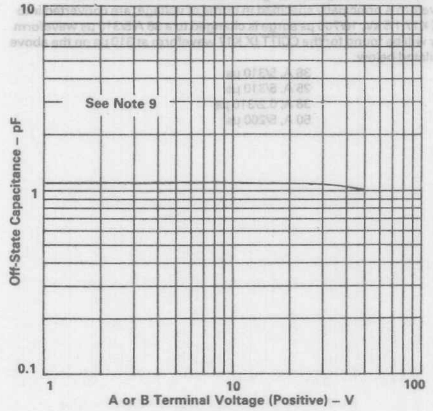


FIGURE 15

OFF-STATE CAPACITANCE
vs
A OR B TERMINAL VOLTAGE (NEGATIVE)

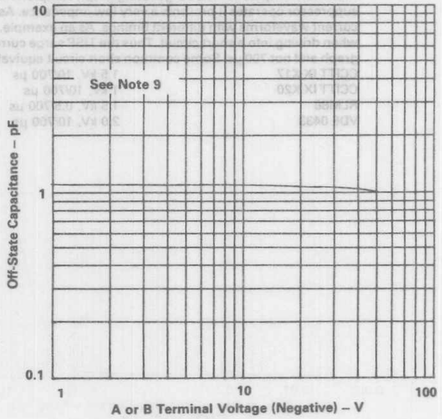


FIGURE 16

NOTES: 8. Third terminal = 0 V to −50 V.
9. Only for C = +50 V.

TYPICAL CHARACTERISTICS

SURGE CURRENT
vs
DECAY TIME

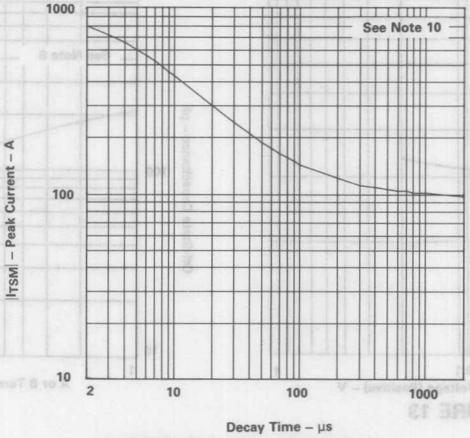


FIGURE 17

NOTE: 10. Most lightning tests, used for equipment verification, specify a unidirectional sawtooth waveform which has an exponential rise and an exponential decay. Waveforms will be specified in terms of a Peak Amplitude (voltage or current), rise time and a decay time to 50% of the maximum amplitude. The surge rating graph comprehends the rise times of commonly used surge waveforms. When the transient suppressor operates it presents a very low impedance. As a result, waveforms principally specified in terms of voltage, are converted into current waveforms with different timings. As an example, the CCITT IX K17 1.5 kV, 10/700 µs surge is changed to a 38 A 5/310 µs waveform when driving into a short circuit. Thus the TISP surge current capability will be found for the CCITT IX K17 waveform at 310 µs on the above graph and not 700 µs. Some common short circuit equivalents are tabulated below:

CCITT IX K17	1.5 kV, 10/700 µs	38 A, 5/310 µs
CCITT IX K20	1 kV, 10/700 µs	25 A, 5/310 µs
RLM88	1.5 kV, 0.5/700 µs	38 A, 0.2/310 µs
VDE 0433	2.0 kV, 10/700 µs	50 A, 5/200 µs

THERMAL INFORMATION

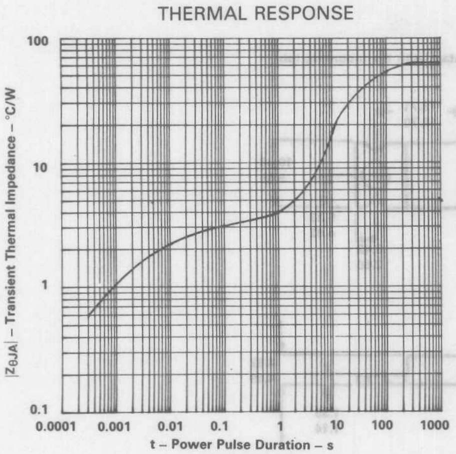


FIGURE 18

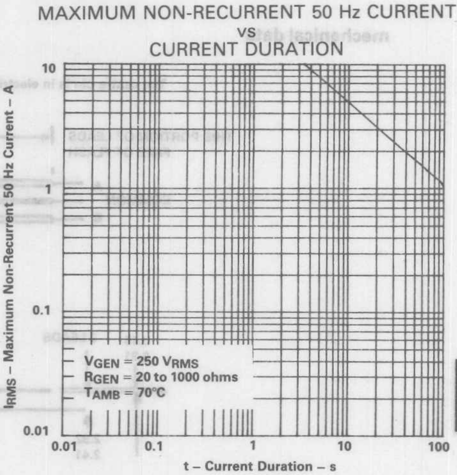


FIGURE 19

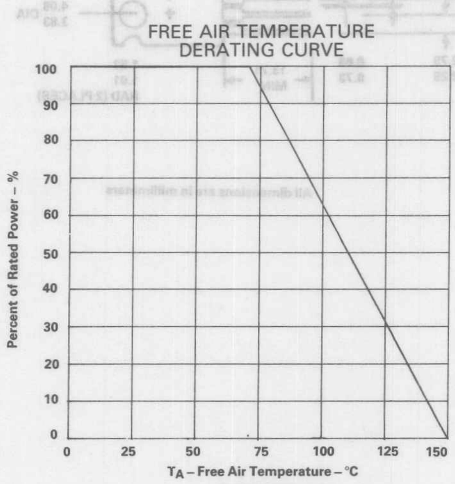
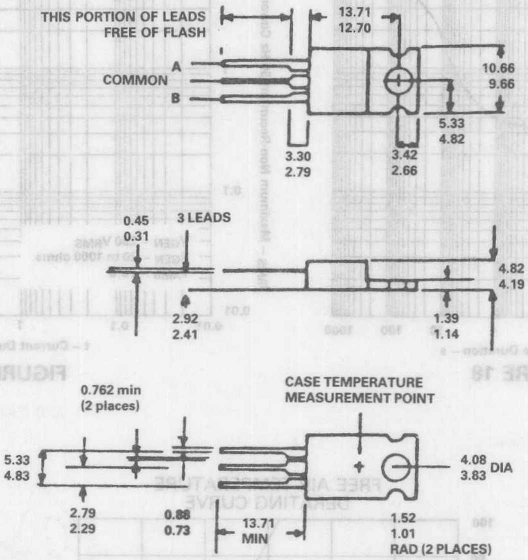


FIGURE 20

mechanical data

The centre pin is in electrical contact with the mounting tab



All dimensions are in millimeters

TISP2082
DUAL SYMMETRICAL TRANSIENT VOLTAGE SUPPRESSORS

APRIL 1987

FOR APPLICATIONS IN TELECOMMUNICATIONS EQUIPMENT

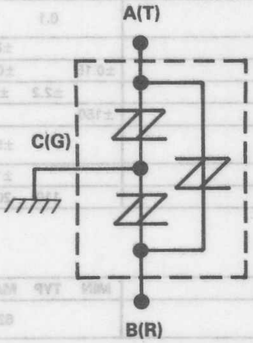
The TISP2082 is designed specifically for telephone equipment protection against lightning and transients induced by ac power lines. These devices will suppress voltage transients between terminals A and C, B and C, and A and B.

Transients are initially clipped by zener action until the voltage rises to the breakover level, which causes the device to crowbar. The high crowbar holding current prevents dc latchup as the transient subsides.

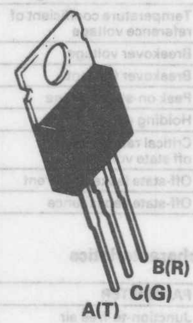
These monolithic protection devices are fabricated in ion-implanted planar structures to ensure precise and symmetrical breakover control.

	TISP2082
• **Breakover Voltage, $V_{(BO)}$ Max**	**82 V**
• **Zener Voltage, V_Z Min**	**58 V**
• **Holding Current, I_H Min**	**150 mA**
• **Surge Rating:**	
ANSI	**150 A**
VDE0433	**2.0 kV**
RLM88	**1.5 kV**
CCITT IX K17	**1.5 kV**

device schematic



TO–220 PACKAGE



Pin C is in electrical contact with the mounting pad.

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absolute maximum rating at 25°C case temperature (unless otherwise noted)

RATING	SYMBOL		UNIT
Non-repetitive peak on-state pulse current			
8/20 μs (ANSI STD C62) (see notes 1,2)	I_{TSP}	150	A
5/210 μs (VDE0433 10/700 μs, 2kV) (see notes 1,2,3)	I_{TSP}	50	A
0.2/310 μs (RML88 0.5/700 μs, 1.5kV) (see notes 1,2,3)	I_{TSP}	38	A
5/310 μs (CCITT IX K17 10/700 μs, 1.5kV) (See notes 1,2,3)	I_{TSP}	38	A
50 Hz RMS on-state current 2.5 s (see notes 1,2)	I_{TSM}	10	A
Initial rate of rise of on-state current	di_T/dt	250	A/μs
Junction temperature	T_{jmax}	150	°C
Operating free air temperature range		0–70	°C
Storage temperature range	T_{stg}	−40 +150	°C
Lead temperature 1.5 mm from case for 10 s	T_{lead}	260	°C

NOTES: 1. Above 70°C, derate linearly to zero at 150°C case temperature.
2. This value applies when the initial case temperature is at (or below) 70°C. The surge may be repeated after the device has returned to thermal equilibrium.
3. Most PTT's quote an unloaded voltage waveform. In operation the TISP essentially shorts the generator output. The resulting loaded current waveform is specified.

electrical characteristics for the A and B terminals, $T_j = 25°C$

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_Z	Reference zener voltage	$I_Z = \pm 1$ mA	±58			V
I_D	Off-state leakage current	$V_D = \pm 50$ V			±10	μA
C_{off}	Off-state capacitance	$V_D = 0$, f = 1 kHz See note 4		70	150	pF

electrical characteristics for the A and C or the B and C terminals, $T_j = 25°C$

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_Z	Reference zener voltage	$I_Z = \pm 1$ mA	±58			V
α_{VZ}	Temperature coefficient of reference voltage			0.1		%/°C
$V_{(BO)}$	Breakover voltage	See Notes 5 and 6			±82	V
$I_{(BO)}$	Breakover Current	See Note 5	±0.15		±0.6	A
V_{TM}	Peak on-state voltage	$I_T = \pm 5$A See Notes 5 and 6		±2.2	±3	V
I_H	Holding current	See Note 5	±150			mA
dv/dt	Critical rate of rise of off state voltage	See Note 7			±5	kV/μs
I_D	Off-state leakage current	$V_D = \pm 50$ V			±10	μA
C_{off}	Off-state capacitance	$V_D = 0$, f= 1 kHz See Note 4		110	200	pF

thermal characteristics

	PARAMETER	MIN	TYP	MAX	UNIT
$R_{\theta JA}$	Junction-to-free air thermal resistance			62.5	°C/W

NOTES: 4. These capacitance measurements employ a three-terminal capacitance bridge incorporating a guard circuit. The third terminal is connected to the guard terminal of the bridge.
5. These parameters must be measured using pulse techniques, t_w = 100 μs, duty cycle ≤2%.
6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.
7. Linear rate of rise, maximum voltage limited to 80% V_Z (minimum).

PARAMETER MEASUREMENT INFORMATION

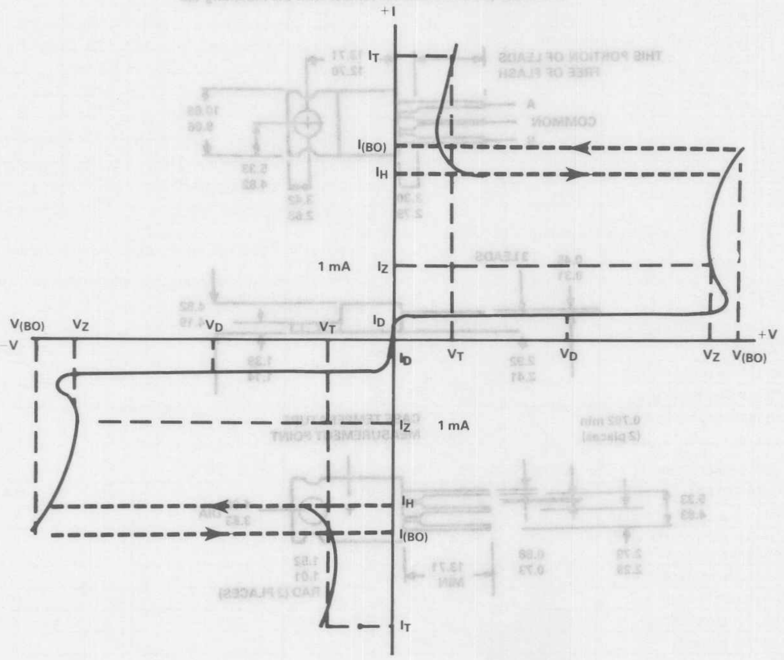
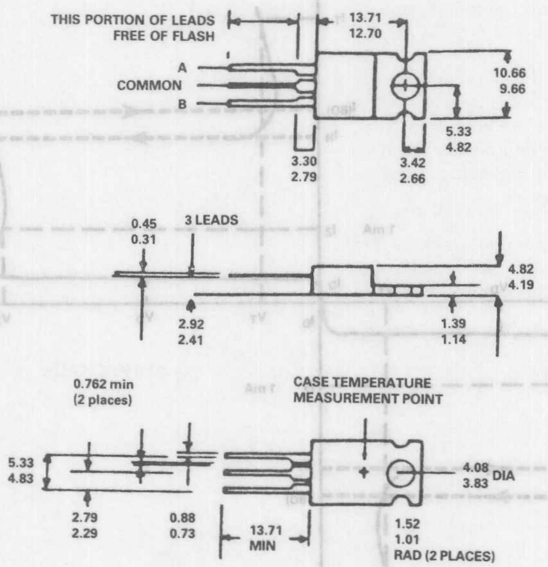


FIGURE 1. VOLTAGE-CURRENT CHARACTERISTICS FOR ANY PAIR OF TERMINALS
The high-level characteristics for terminals A and B are not guaranteed.

mechanical data

The centre pin is in electrical contact with the mounting tab



All dimensions are in millimeters

TISP2180, TISP2290
DUAL SYMMETRICAL TRANSIENT VOLTAGE SUPPRESSORS

NOVEMBER 1986–REVISED APRIL 1987

FOR APPLICATIONS IN TELECOMMUNICATIONS EQUIPMENT

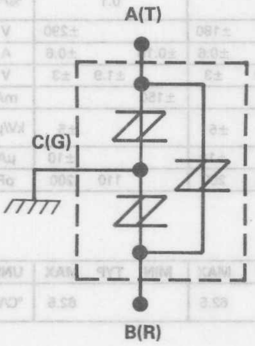
The TISP2000 series is designed specifically for telephone equipment protection against lightning and transients induced by ac power lines. These devices will suppress voltage transients between terminals A and C, B and C, and A and B.

Transients are initially clipped by zener action until the voltage rises to the breakover level, which causes the device to crowbar. The high crowbar holding current prevents dc latchup as the transient subsides.

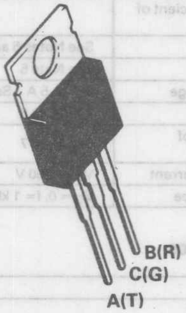
These monolithic protection devices are fabricated in ion-implanted planar structures to ensure precise and symmetrical breakover control.

	TISP2180	TISP2290
• **Breakover Voltage, $V_{(BO)}$ Max**	**180 V**	**290 V**
• **Zener Voltage, V_Z Min**	**145 V**	**200 V**
• **Holding Current, I_H Min**	**150 mA**	
• **Surge Rating:**		
ANSI	**150 A**	
VDE0433	**2.0 kV**	
RLM88	**1.5 kV**	
CCITT IX K17	**1.5 kV**	

device schematic



TO–220 PACKAGE



Pin C is in electrical contact with the mounting pad.

PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

TEXAS INSTRUMENTS

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absolute maximum rating at 25°C case temperature (unless otherwise noted)

RATING	SYMBOL		UNIT
Non-repetitive peak on-state pulse current			
8/20 µs (ANSI STD C62) (see notes 1,2)	I_{TSP}	150	A
5/200 µs (VDE0433 10/700 µs, 2kV) (see notes 1,2,3)	I_{TSP}	50	A
0.2/310 µs (RLM88 0.5/700 µs, 1.5kV) (see notes 1,2,3)	I_{TSP}	38	A
5/310 µs (CCITT IX K17 10/700 µs, 1.5kV) (See notes 1,2,3)	I_{TSP}	38	A
50 Hz RMS on-state current 2.5 s (see notes 1,2)	I_{TSM}	10	A
Initial rate of rise of on-state current	di_t/dt	250	A/µs
Junction temperature	T_{jmax}	150	°C
Operating free air temperature range		0–70	°C
Storage temperature range	T_{stg}	−40+150	°C
Lead temperature 1.5 mm from case for 10 s	T_{lead}	260	°C

NOTES: 1. Above 70°C, derate linearly to zero at 150°C case temperature.
2. This value applies when the initial case temperature is at (or below) 70°C. The surge may be repeated after the device has returned to thermal equilibrium.
3. Most PTT's quote an unloaded voltage waveform. In operation the TISP essentially shorts the generator output. The resulting loaded current waveform is specified.

electrical characteristics for the A and B terminals, $T_j = 25°C$

			TISP2180			TISP2290			
	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
V_Z	Reference zener voltage	$I_Z = \pm 1$ mA	±145			±200			V
I_D	Off-state leakage current	$V_D = \pm 50$ V			±10			±10	µA
C_{off}	Off-state capacitance	$V_D = 0$, f= 1 kHz See Note 4		40	100		40	100	pF

electrical characteristics for the A and C or the B and C terminals, $T_J = 25°C$

V_Z	Reference zener voltage	$I_Z = \pm 1$ mA	±145			±200			V
$\propto_{VZ}$	Temperature coefficient of reference voltage			0.1			0.1		%/°C
$V_{(BO)}$	Breakover voltage	See Notes 5 and 6			±180			±290	V
$I_{(BO)}$	Breakover Current	See Note 5	±0.15		±0.6	±0.15		±0.6	A
V_{TM}	Peak On-state voltage	$I_T = \pm 5$ A See Notes 5 and 6		±2.2	±3		±1.9	±3	V
I_H	Holding current	See Note 5	±150			±150			mA
dv/dt	Critical rate of rise of off-state voltage	See Note 7			±5			±5	kV/µs
I_D	Off-state leakage current	$V_D = \pm 50$ V			±10			±10	µA
C_{off}	Off-state capacitance	$V_D = 0$, f= 1 kHz See Note 4		110	200		110	200	pF

thermal characteristics

	PARAMETER	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
$R_{\theta JA}$	Junction-to-free air thermal resistance			62.5			62.5	°C/W

NOTES: 4. These capacitance measurements employ a three-terminal capacitance bridge incorporating a guard circuit. The third terminal is connected to the guard terminal of the bridge.
5. These parameters must be measured using pulse techniques, $t_w = 100$ µs, duty cycle ≤2%.
6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.
7. Linear rate of rise, maximum voltage limited to 80% V_Z (minimum).

PARAMETER MEASUREMENT INFORMATION

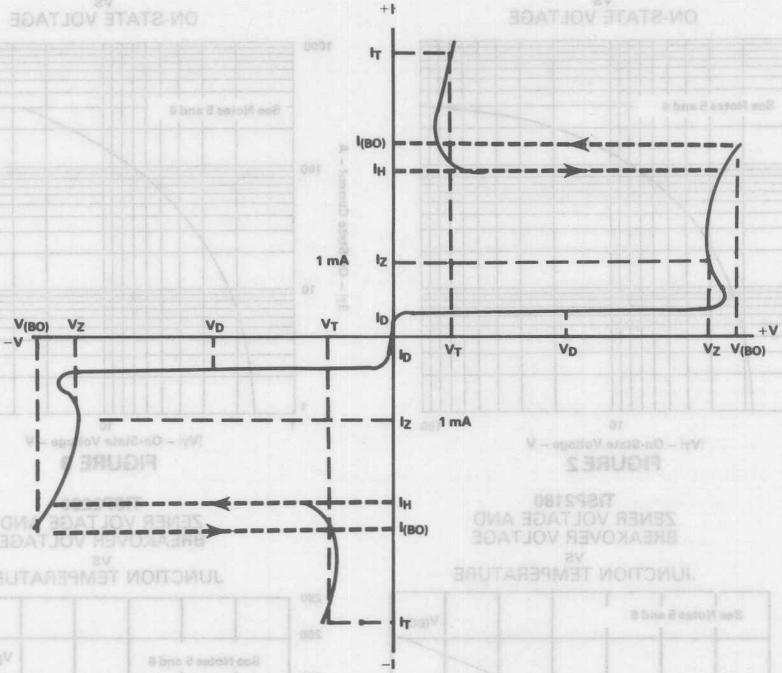
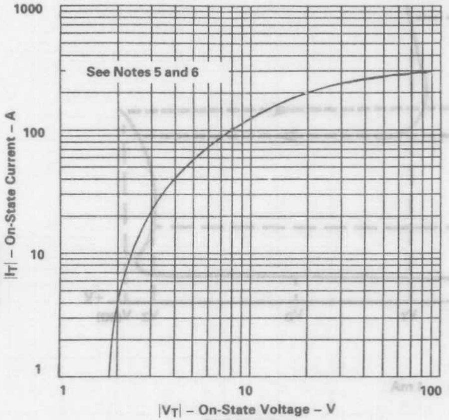


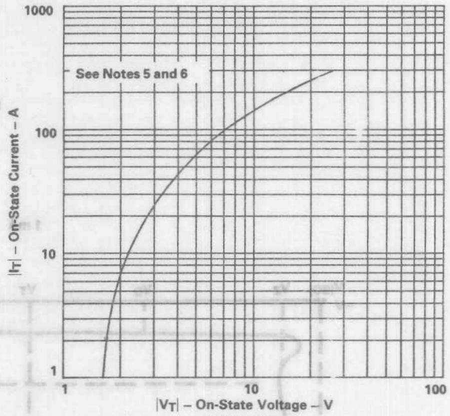
FIGURE 1. VOLTAGE-CURRENT CHARACTERISTICS FOR ANY PAIR OF TERMINALS
The high level characteristics for terminals A and B are not guaranteed.

TYPICAL CHARACTERISTICS
for the A and C, or
the B and C terminals



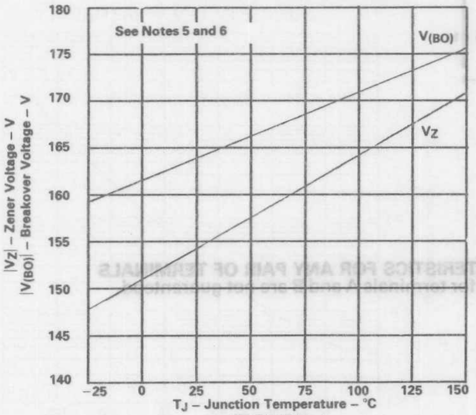
TISP2180
ON-STATE CURRENT
vs
ON-STATE VOLTAGE

FIGURE 2



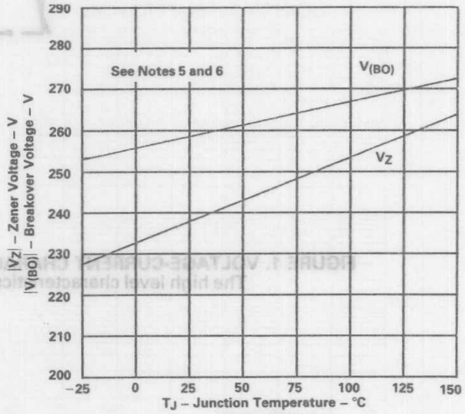
TISP2290
ON-STATE CURRENT
vs
ON-STATE VOLTAGE

FIGURE 3



TISP2180
ZENER VOLTAGE AND
BREAKOVER VOLTAGE
vs
JUNCTION TEMPERATURE

FIGURE 4



TISP2290
ZENER VOLTAGE AND
BREAKOVER VOLTAGE
vs
JUNCTION TEMPERATURE

FIGURE 5

NOTES: 5. These parameters must be measured using pulse techniques, t_w = 100 µs, duty cycle ≤2%.
6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.

TYPICAL CHARACTERISTICS
for the A and C, or
the B and C terminals

TISP2180
HOLDING CURRENT AND
BREAKOVER CURRENT
VS
JUNCTION TEMPERATURE

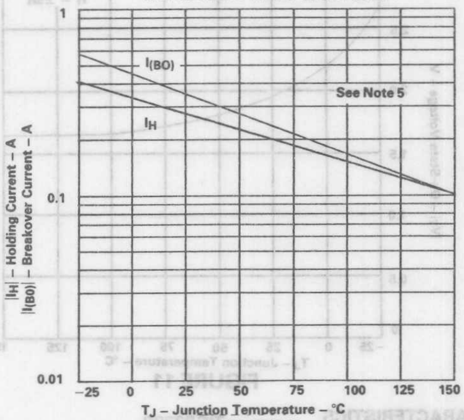


FIGURE 6

TISP2290
HOLDING CURRENT AND
BREAKOVER CURRENT
VS
JUNCTION TEMPERATURE

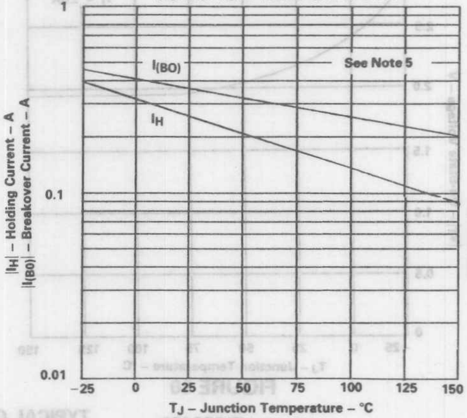


FIGURE 7

TISP2180
LEAKAGE CURRENT
VS
JUNCTION TEMPERATURE

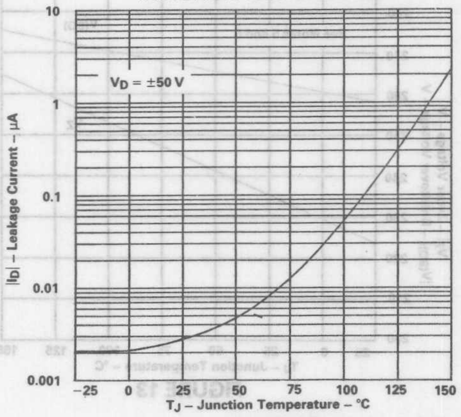


FIGURE 8

TISP2290
LEAKAGE CURRENT
VS
JUNCTION TEMPERATURE

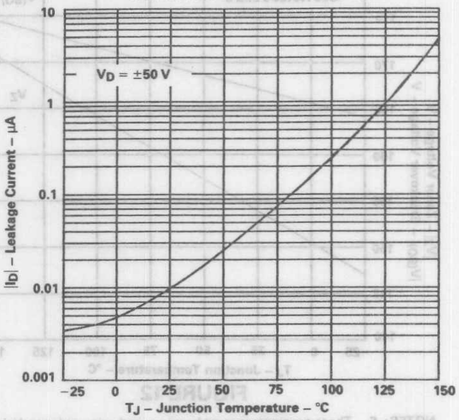


FIGURE 9

NOTES: 5. These parameters must be measured using pulse techniques, t_w = 100 µs, duty cycle ≤2%.

TYPICAL CHARACTERISTICS
for the A and C, or the B and C terminals

TISP2180
ON-STATE VOLTAGE
vs
JUNCTION TEMPERATURE

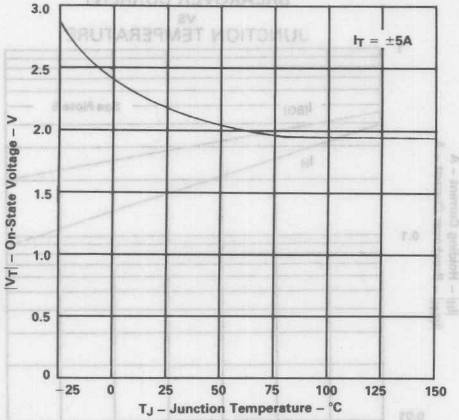


FIGURE 10

TISP2290
ON-STATE VOLTAGE
vs
JUNCTION TEMPERATURE

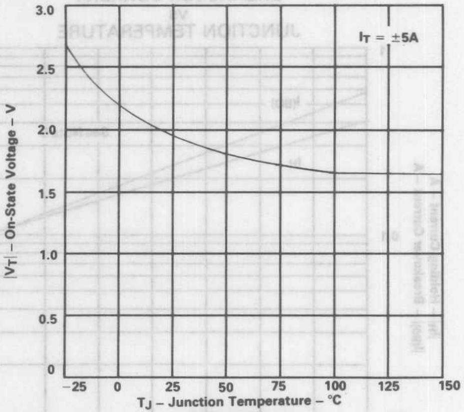


FIGURE 11

TYPICAL CHARACTERISTICS
for the A and B terminals

TISP2180
ZENER VOLTAGE AND
BREAKOVER VOLTAGE
vs
JUNCTION TEMPERATURE

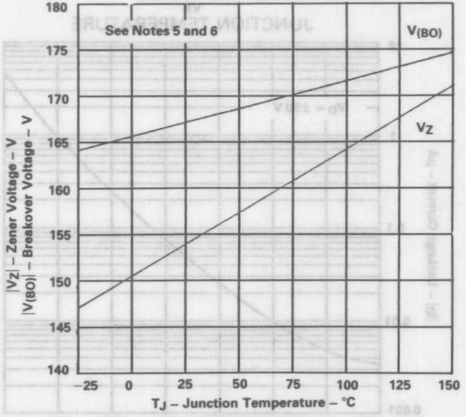


FIGURE 12

TISP2290
ZENER VOLTAGE AND
BREAKOVER VOLTAGE
vs
JUNCTION TEMPERATURE

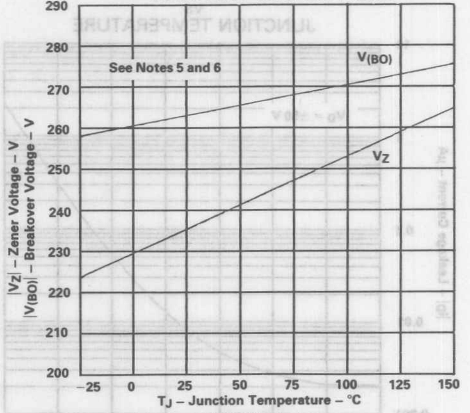


FIGURE 13

NOTES: 5. These parameters must be measured using pulse techniques, $t_W = 100$ µs, duty cycle ≤2%.

6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.

TYPICAL CHARACTERISTICS for the A and B terminals

TISP2180 HOLDING CURRENT AND BREAKOVER CURRENT vs JUNCTION TEMPERATURE

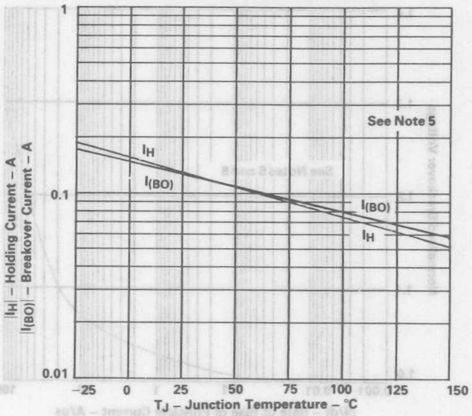


FIGURE 14

TISP2290 HOLDING CURRENT AND BREAKOVER CURRENT vs JUNCTION TEMPERATURE

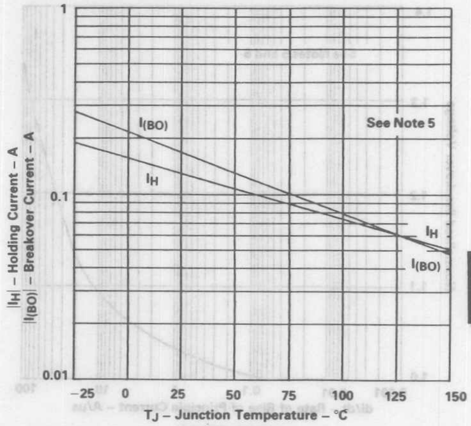


FIGURE 15

TISP2180 LEAKAGE CURRENT vs JUNCTION TEMPERATURE

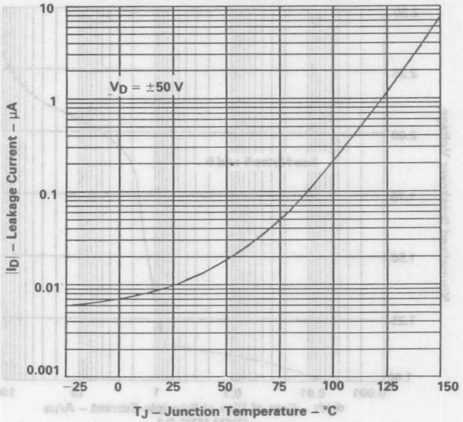


FIGURE 16

TISP2290 LEAKAGE CURRENT vs JUNCTION TEMPERATURE

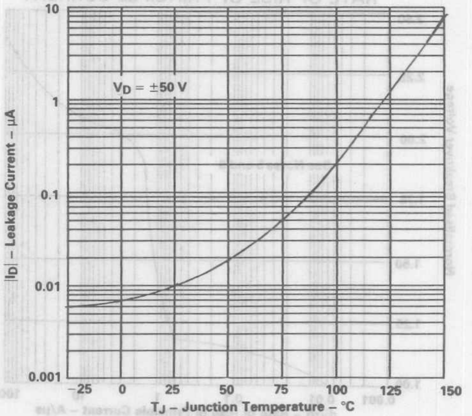


FIGURE 17

NOTES: 5. These parameters must be measured using pulse techniques, t_w = 100 µs, duty cycle ≤2%.

TYPICAL CHARACTERISTICS
for the A and C, B and C terminals

TISP2180
NORMALISED BREAKOVER VOLTAGE
vs
RATE OF RISE OF PRINCIPLE CURRENT

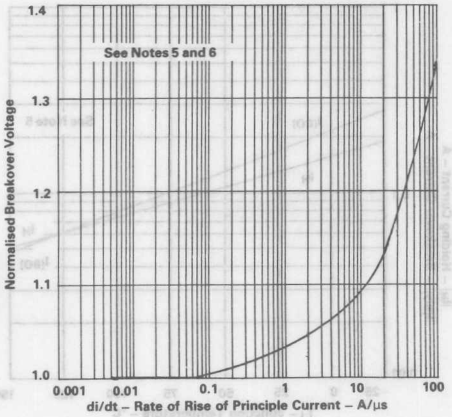


FIGURE 18

TISP2290
NORMALISED BREAKOVER VOLTAGE
vs
RATE OF RISE OF PRINCIPLE CURRENT

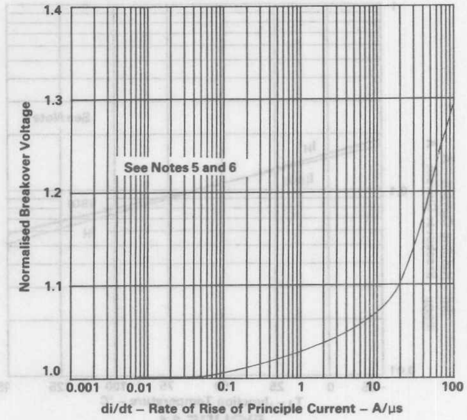


FIGURE 19

TYPICAL CHARACTERISTICS
for the A and B terminals

TISP2180
NORMALISED BREAKOVER VOLTAGE
vs
RATE OF RISE OF PRINCIPLE CURRENT

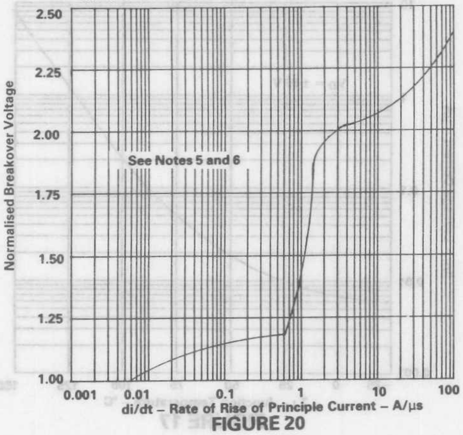


FIGURE 20

TISP2290
NORMALISED BREAKOVER VOLTAGE
vs
RATE OF RISE OF PRINCIPLE CURRENT

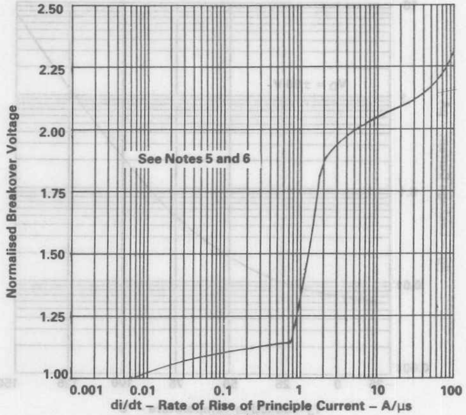


FIGURE 21

NOTES: 5. These parameters must be measured using pulse techniques, t_w = 100 μs, duty cycle ≤2%.
6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.

TYPICAL CHARACTERISTICS
for the A and C, B and C terminals†

TISP2180
OFF-STATE CAPACITANCE
vs
TERMINAL VOLTAGE (POSITIVE)

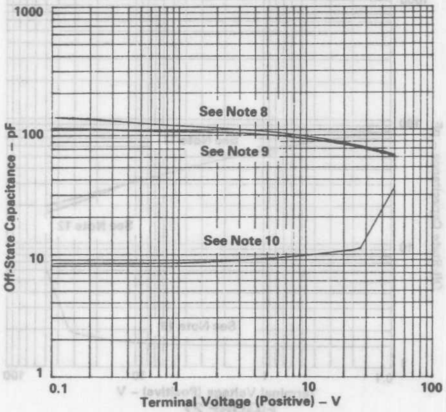


FIGURE 22

TISP2290
OFF-STATE CAPACITANCE
vs
TERMINAL VOLTAGE (POSITIVE)

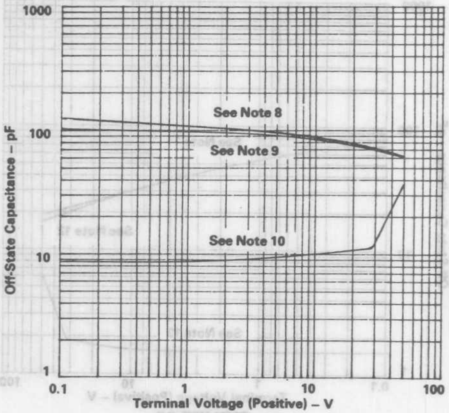


FIGURE 23

TISP2180
OFF-STATE CAPACITANCE
vs
TERMINAL VOLTAGE (NEGATIVE)

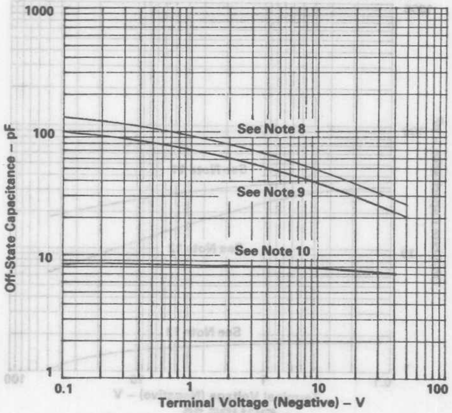


FIGURE 24

TISP2290
OFF-STATE CAPACITANCE
vs
TERMINAL VOLTAGE (NEGATIVE)

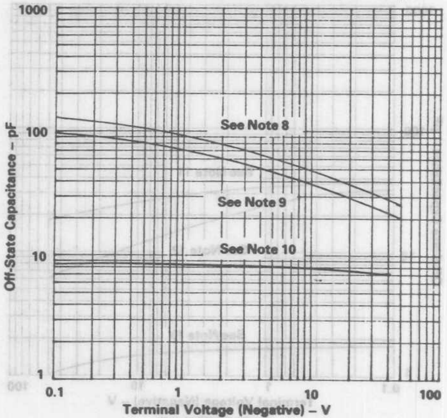


FIGURE 25

† Polarity is determined at terminal A or B with respect to C

NOTES: 8. Third terminal bias = −50 V.
9. Third terminal bias = 0 V.
10. Third terminal bias = +50 V.

TYPICAL CHARACTERISTICS
for the A and B terminals

TISP2180
OFF-STATE CAPACITANCE
vs
TERMINAL VOLTAGE (POSITIVE)

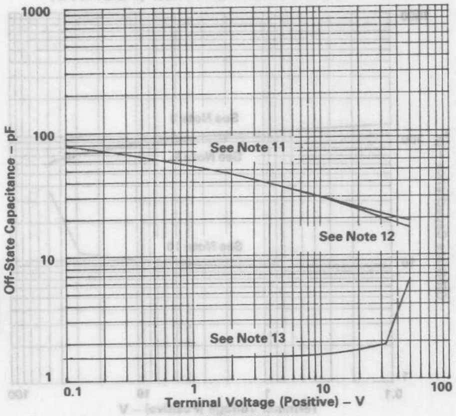


FIGURE 26

TISP2290
OFF-STATE CAPACITANCE
vs
TERMINAL VOLTAGE (POSITIVE)

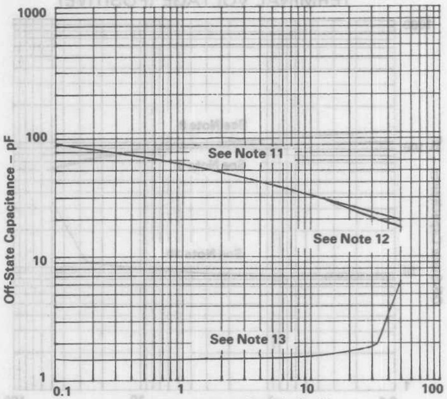


FIGURE 27

TISP2180
OFF-STATE CAPACITANCE
vs
TERMINAL VOLTAGE (NEGATIVE)

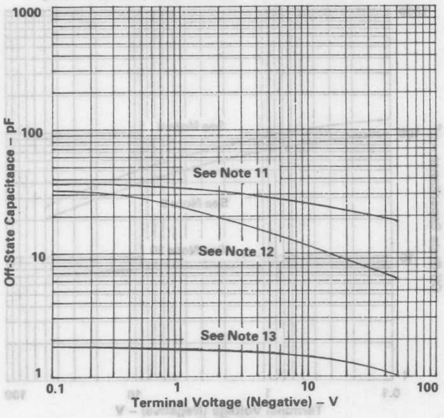


FIGURE 28

TISP2290
OFF-STATE CAPACITANCE
vs
TERMINAL VOLTAGE (NEGATIVE)

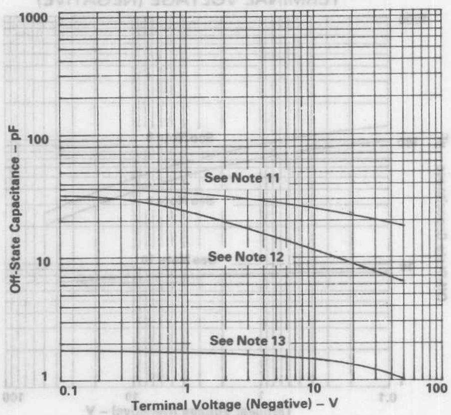


FIGURE 29

NOTES: 11. Third terminal bias = −50 V.
12. Third terminal bias = 0 V.
13. Third terminal bias = +50 V.

TYPICAL CHARACTERISTICS

SURGE CURRENT
vs
DECAY TIME

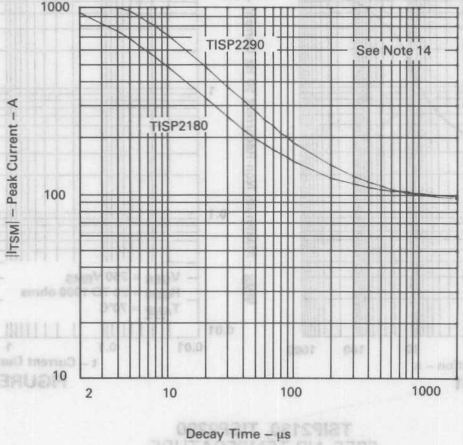


FIGURE 30

14. Most lightning tests, used for equipment verification, specify a unidirectional sawtooth waveform which has an exponential rise and an exponential decay time to 50% of the maximum amplitude. The surge rating graph comprehends the rise times of commonly used surge waveforms. When the transient suppressor operates it presents a very low impedance. As a result, waveforms principally specified in terms of voltage, are converted into current waveforms with different timings. As an example, the CCITT IX K17 1.5kV, 10/700 µs surge is changed to a 38A, 5/310 µs waveform when driving into a short circuit. Thus the TISP surge current capability will be found for the CCITT IX K17 waveform at 310 µs on the above graph and not 700 µs. Some common short circuit equivalents are tabulated below:

CCITT IX K17	1.5 kV, 10/700 µs	38A, 5/310 µs
CCITT IX K20	1 kV, 10/700 µs	25A, 5/310 µs
RLM88	1.5kV, 0.5/700 µs	38A, 0.2/310 µs
VDE 0433	2.0kV, 10/700 µs	50A, 5/200 µs

THERMAL INFORMATION

TISP2180, TISP2290
THERMAL RESPONSE

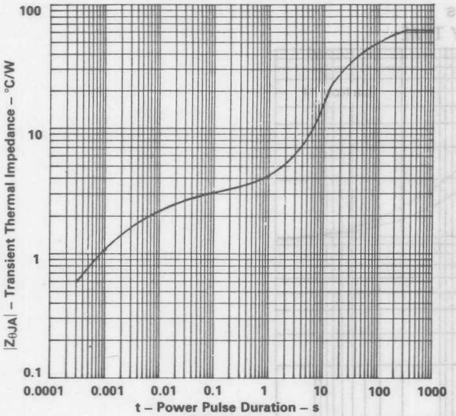


FIGURE 31

TISP2180, TISP2290
MAXIMUM NON-RECURRING 50 Hz CURRENT
vs
CURRENT DURATION

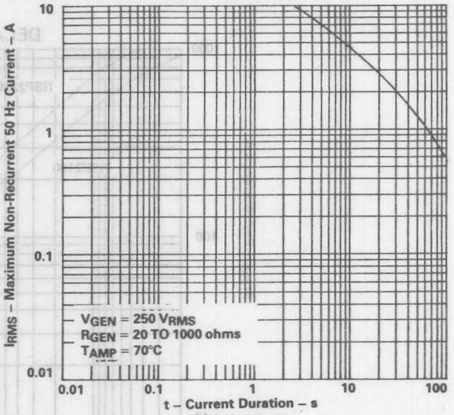


FIGURE 32

TSIP2180, TISP2290
FREE AIR TEMPERATURE
DERATING CURVE

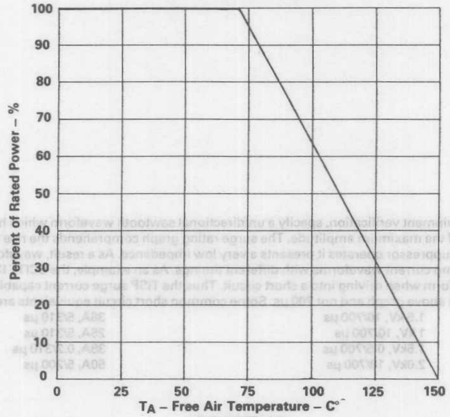
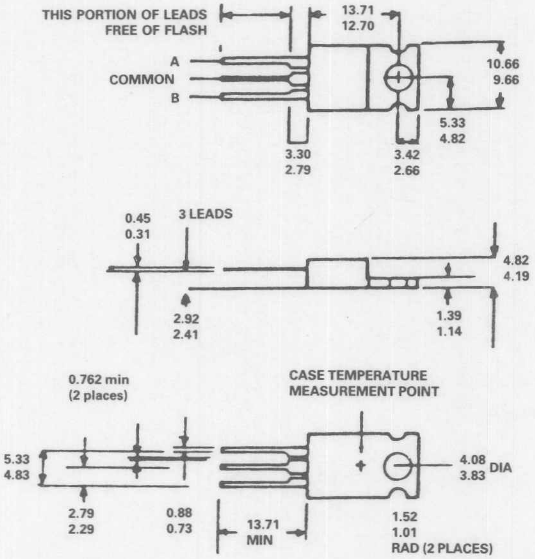


FIGURE 33

mechanical data

Pin A is in electrical contact with the mounting tab



All dimensions are in millimeters

TISP3082
DUAL SYMMETRICAL TRANSIENT VOLTAGE SUPPRESSORS

APRIL 1987

FOR APPLICATIONS IN TELECOMMUNICATIONS EQUIPMENT

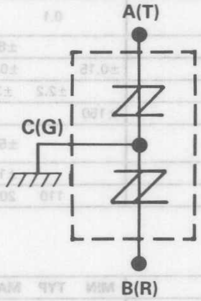
	TISP3082
- **Breakover Voltage, $V_{(BO)}$ Max**	**82 V**
- **Zener Voltage, V_Z Min**	**58 V**
- **Holding Current, I_H Min**	**150 mA**
- **Surge Rating:**	
ANSI	**150 A**
VDE0433	**2.0 kV**
RLM88	**1.5 kV**
CCITT IX K17	**1.5 kV**

The TISP3082 is designed specifically for telephone equipment protection against lightning and transients induced by ac power lines. These devices consist of two bidirectional suppressor elements connected to a Common (C) terminal. They will suppress voltage transients between terminals A and C, B and C, and A and B.

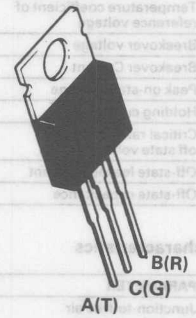
Transients are initially clipped by zener action until the voltage rises to the breakover level, which causes the device to crowbar. The high crowbar holding current prevents dc latchup as the transient subsides.

These monolithic protection devices are fabricated in ion-implanted planar structures to ensure precise and symmetrical breakover control.

device schematic



TO–220 PACKAGE



Pin C is in electrical contact with the mounting pad.

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TEXAS INSTRUMENTS

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TISP3082
DUAL SYMMETRICAL TRANSIENT VOLTAGE SUPPRESSORS

APRIL 1987

absolute maximum rating at 25°C case temperature (unless otherwise noted)

RATING	SYMBOL		UNIT
Non-repetitive peak on-state pulse current			
8/20 μs (ANSI STD C62) (see notes 1,2)	I_{TSP}	150	A
5/210 μs (VDE0433 10/700 μs, 2kV) (See notes 1,2,3)	I_{TSP}	50	A
0.2/310 μs (RML88 0.5/700 μs, 1.5kV) (see notes 1,2,3)	I_{TSP}	38	A
5/310 μs (CCITT IX K17 10/700 μs, 1.5kV) (See notes 1,2,3)	I_{TSP}	38	A
50 Hz RMS on-state current 2.5 s (see notes 1,2)	I_{TSM}	10	A
Initial rate of rise of on-state current	di_t/dt	250	A/μs
Junction temperature	T_{jmax}	150	°C
Operating free air temperature range		0–70	°C
Storage temperature range	T_{stg}	−40 +150	°C
Lead temperature 1.5 mm from case for 10 s	T_{lead}	260	°C

NOTES:
1. Above 70°C, derate linearly to zero at 150°C case temperature.
2. This value applies when the initial case temperature is at (or below) 70°C. The surge may be repeated after the device has returned to thermal equilibrium.
3. Most PTT's quote an unloaded voltage waveform. In operation the TISP essentially shorts the generator output. The resulting loaded current waveform is specified.

electrical characteristics for the A and B terminals, $T_j = 25°C$

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_Z	Reference zener voltage	$I_Z = \pm 1$ mA	±116			V
I_D	Off-state leakage current	$V_D = \pm 50$ V			±10	μA
C_{off}	Off-state capacitance	$V_D = 0$, f = 1 kHz See note 4		0.5	5	pF

electrical characteristics for the A and C or the B and C terminals, $T_j = 25°C$

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_Z	Reference zener voltage	$I_Z = \pm 1$ mA	±58			V
$^{\alpha}V_Z$	Temperature coefficient of reference voltage			0.1		%/°C
$V_{(BO)}$	Breakover voltage	See Notes 5 and 6			±82	V
$I_{(BO)}$	Breakover Current	See Note 5	±0.15		±0.6	A
V_{TM}	Peak on-state voltage	$I_T = \pm 5$A See Notes 5 and 6		±2.2	±3	V
I_H	Holding current	See Note 5	±150			mA
dv/dt	Critical rate of rise of off state voltage	See Note 7			±5	kV/μs
I_D	Off-state leakage current	$V_D = \pm 50$ V			±10	μA
C_{off}	Off-state capacitance	$V_D = 0$, f= 1 kHz See Note 4		110	200	pF

thermal characteristics

	PARAMETER	MIN	TYP	MAX	UNIT
$R_{\theta JA}$	Junction-to-free air thermal resistance			62.5	°C/W

NOTES:
4. These capacitance measurements employ a three-terminal capacitance bridge incorporating a guard circuit. The third terminal is connected to the guard terminal of the bridge.
5. These parameters must be measured using pulse techniques, $t_w = 100$ μs, duty cycle ≤2%.
6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.
7. Linear rate of rise, maximum voltage limited to 80% V_Z (minimum).

PARAMETER MEASUREMENT INFORMATION

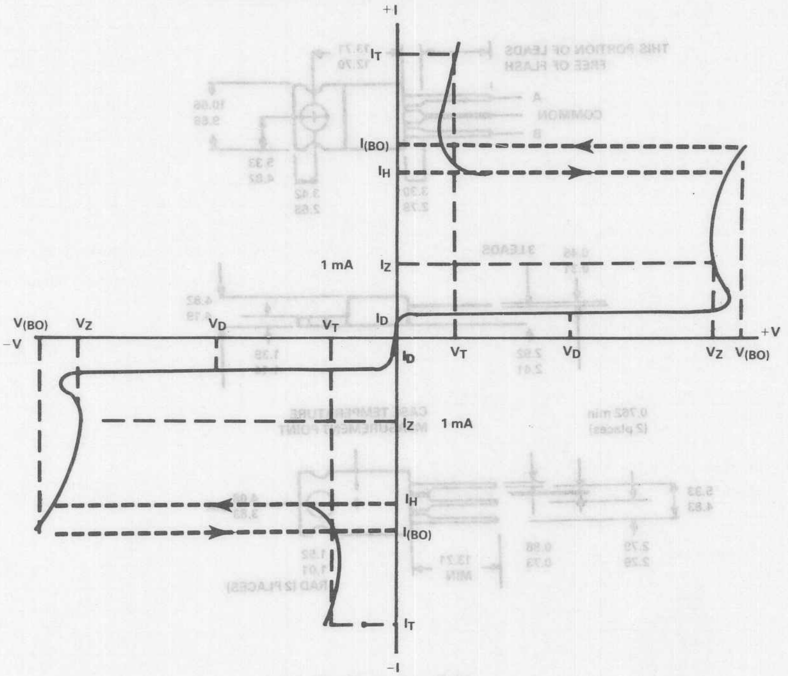
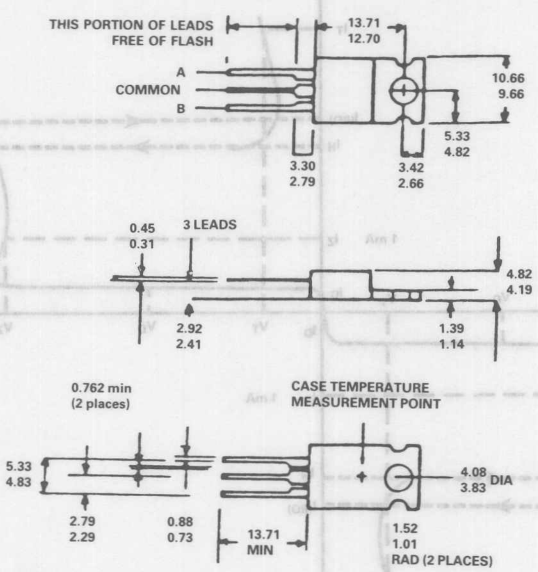


FIGURE 1. VOLTAGE-CURRENT CHARACTERISTICS FOR TERMINALS A AND C OR B AND C

mechanical data

The centre pin is in electrical contact with the mounting tab



All dimensions are in millimeters

TISP3180
DUAL SYMMETRICAL TRANSIENT VOLTAGE SUPPRESSORS

NOVEMBER1986 – REVISED APRIL 1987

FOR APPLICATIONS IN
TELECOMMUNICATIONS EQUIPMENT

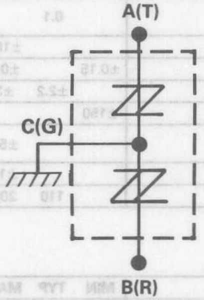
The TISP3180 is designed specifically for telephone equipment protection against lightning and transients induced by ac power lines. These devices consist of two bidirectional suppressor elements connected to a Common (C) terminal. They will suppress voltage transients between terminals A and C, B and C, and A and B.

Transients are initially clipped by zener action until the voltage rises to the breakover level, which causes the device to crowbar. The high crowbar holding current prevents dc latchup as the transient subsides.

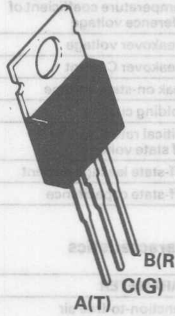
These monolithic protection devices are fabricated in ion-implanted planar structures to ensure precise and symmetrical breakover control.

	TISP3180
• **Breakover Voltage, $V_{(BO)}$ Max**	**180 V**
• **Zener Voltage, V_Z Min**	**145 V**
• **Holding Current, I_H Min**	**150 mA**
• **Surge Rating:**	
ANSI	**150 A**
VDE0433	**2.0 kV**
RLM88	**1.5 kV**
CCITT IX K17	**1.5 kV**

device schematic



TO–220 PACKAGE



Pin C is in electrical contact with the mounting pad.

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absolute maximum rating at 25°C case temperature (unless otherwise noted)

RATING	SYMBOL		UNIT
Non-repetitive peak on-state pulse current			
8/20 μs (ANSI STD C62) (see notes 1,2)	I_{TSP}	150	A
5/210 μs (VDE0433 10/700 μs, 2kV) (see notes 1,2,3)	I_{TSP}	50	A
0.2/310 μs (RML88 0.5/700 μs, 1.5kV) (see notes 1,2,3)	I_{TSP}	38	A
5/310 μs (CCITT IX K17 10/700 μs, 1.5kV) (See notes 1,2,3)	I_{TSP}	38	A
50 Hz RMS on-state current 2.5 s (see notes 1,2)	I_{TSM}	10	A
Initial rate of rise of on-state current	di_t/dt	250	A/μs
Junction temperature	T_{jmax}	150	°C
Operating free air temperature range		0–70	°C
Storage temperature range	T_{stg}	–40 +150	°C
Lead temperature 1.5 mm from case for 10 s	T_{lead}	260	°C

NOTES: 1. Above 70°C, derate linearly to zero at 150°C case temperature.
2. This value applies when the initial case temperature is at (or below) 70°C. The surge may be repeated after the device has returned to thermal equilibrium.
3. Most PTT's quote an unloaded voltage waveform. In operation the TISP essentially shorts the generator output. The resulting loaded current waveform is specified.

electrical characteristics for the A and B terminals, $T_j = 25°C$

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_Z	Reference zener voltage	$I_Z = \pm 1$ mA	±290			V
I_D	Off-state leakage current	$V_D = \pm 50$ V			±10	μA
C_{off}	Off-state capacitance	$V_D = 0$, f = 1 kHz See note 4		0.5	5	pF

electrical characteristics for the A and C or the B and C terminals, $T_j = 25°C$

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_Z	Reference zener voltage	$I_Z = \pm 1$ mA	±145			V
α_{VZ}	Temperature coefficient of reference voltage			0.1		%/°C
$V_{(BO)}$	Breakover voltage	See Notes 5 and 6			±180	V
$I_{(BO)}$	Breakover Current	See Note 5	±0.15		±0.6	A
V_{TM}	Peak on-state voltage	$I_T = \pm 5$A See Notes 5 and 6		±2.2	±3	V
I_H	Holding current	See Note 5	±150			mA
dv/dt	Critical rate of rise of off state voltage	See Note 7			±5	kV/μs
I_D	Off-state leakage current	$V_D = \pm 50$ V			±10	μA
C_{off}	Off-state capacitance	$V_D = 0$, f= 1 kHz See Note 4		110	200	pF

thermal characteristics

	PARAMETER	MIN	TYP	MAX	UNIT
$R_{\theta JA}$	Junction-to-free air thermal resistance			62.5	°C/W

NOTES: 4. These capacitance measurements employ a three-terminal capacitance bridge incorporating a guard circuit. The third terminal is connected to the guard terminal of the bridge.
5. These parameters must be measured using pulse techniques, $t_w = 100$ μs, duty cycle ≤2%.
6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.
7. Linear rate of rise, maximum voltage limited to 80% V_Z (minimum).

PARAMETER MEASUREMENT INFORMATION

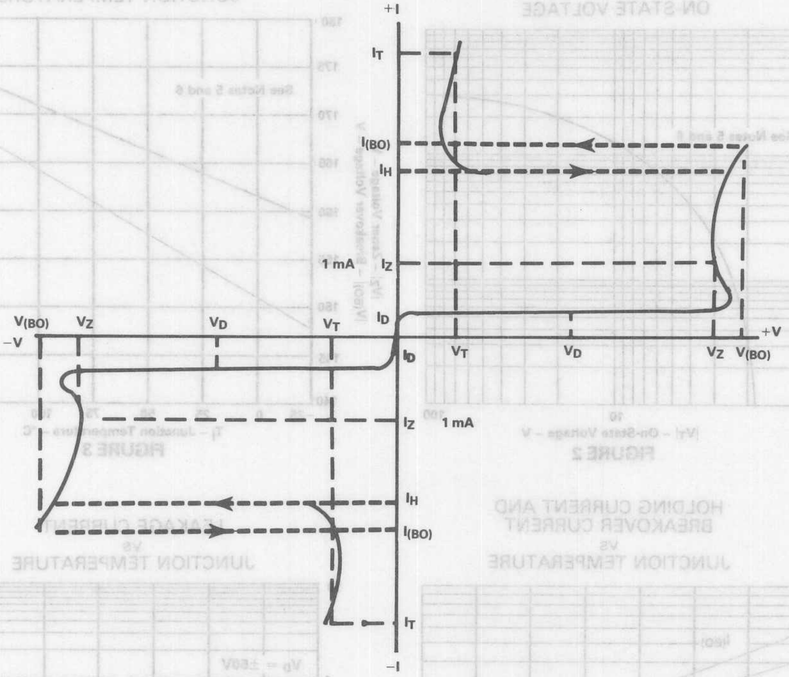


FIGURE 1. VOLTAGE-CURRENT CHARACTERISTICS FOR TERMINALS A AND C OR B AND C

TYPICAL CHARACTERISTICS for the A and C, or the B and C terminals

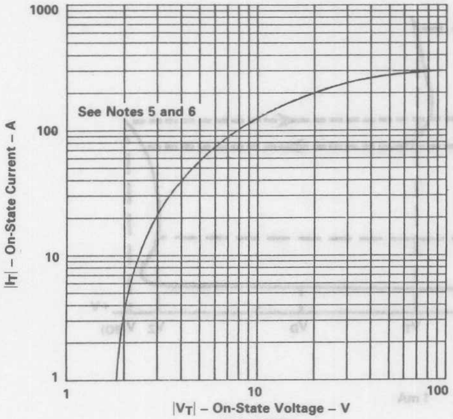

ON-STATE CURRENT vs ON-STATE VOLTAGE

FIGURE 2

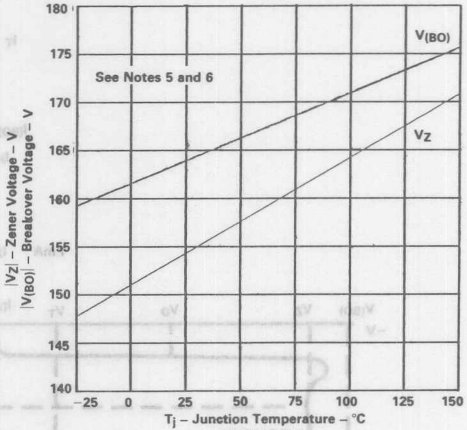

ZENER VOLTAGE AND BREAKOVER VOLTAGE vs JUNCTION TEMPERATURE

FIGURE 3

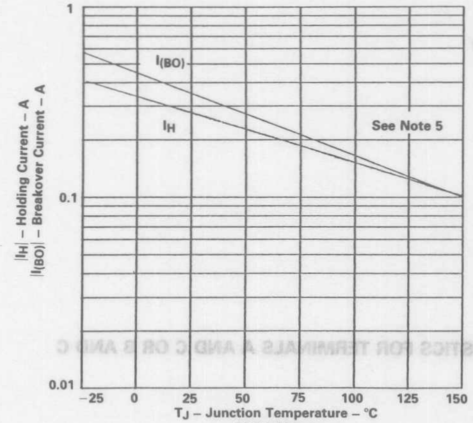

HOLDING CURRENT AND BREAKOVER CURRENT vs JUNCTION TEMPERATURE

FIGURE 4

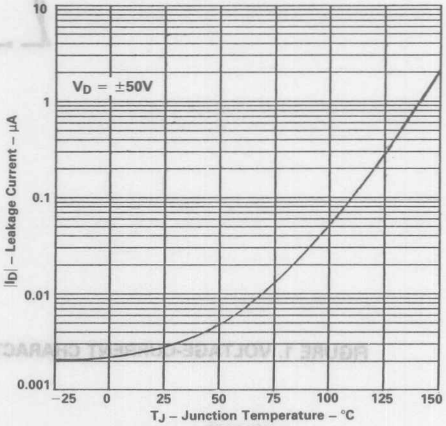

LEAKAGE CURRENT vs JUNCTION TEMPERATURE

FIGURE 5

5. These parameters must be measured using pulse techniques, t_w = 100 μs, duty cycle ≤2%.
6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.

TYPICAL CHARACTERISTICS
for the A and C, or the B and C terminals

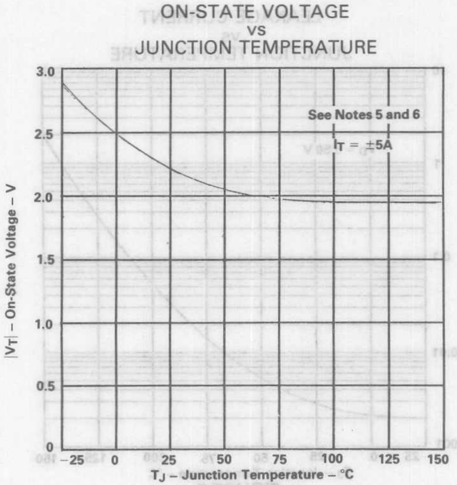


FIGURE 6

TYPICAL CHARACTERISTICS
for the A and B terminals

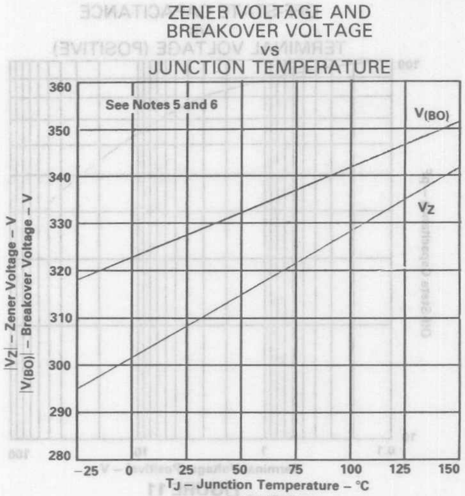


FIGURE 7

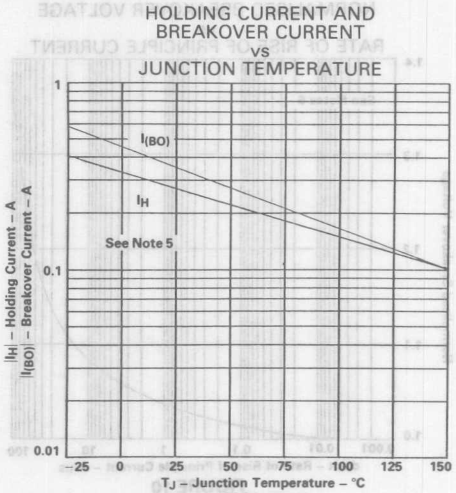


FIGURE 8

5. These parameters must be measured using pulse techniques, $t_w = 100\ \mu s$, duty cycle $\leq 2\%$.
6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.

TYPICAL CHARACTERISTICS
for the A and B terminals

LEAKAGE CURRENT
vs
JUNCTION TEMPERATURE

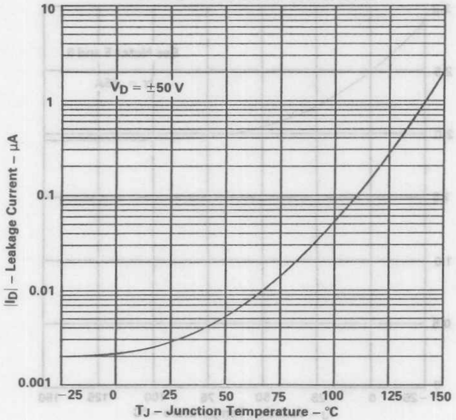


FIGURE 9

TYPICAL CHARACTERISTICS
for the A and C, or the B and C terminals†

NORMALISED BREAKOVER VOLTAGE
vs
RATE OF RISE OF PRINCIPLE CURRENT

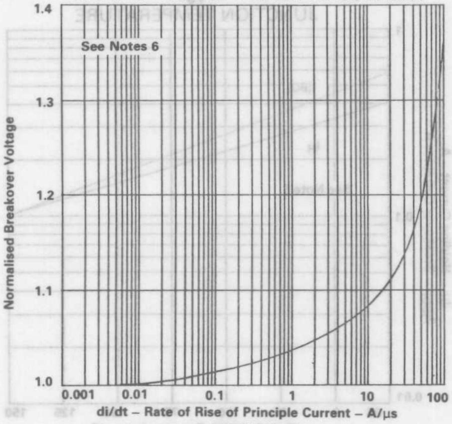


FIGURE 10

OFF-STATE CAPACITANCE
vs
TERMINAL VOLTAGE (POSITIVE)

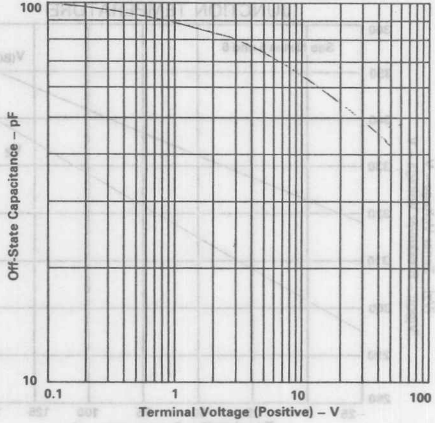


FIGURE 11

† Polarity is determined at terminal A or B with respect to C

6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.

TYPICAL CHARACTERISTICS
for the A and C, or the B and C terminals†

OFF-STATE CAPACITANCE
vs
TERMINAL VOLTAGE (NEGATIVE)

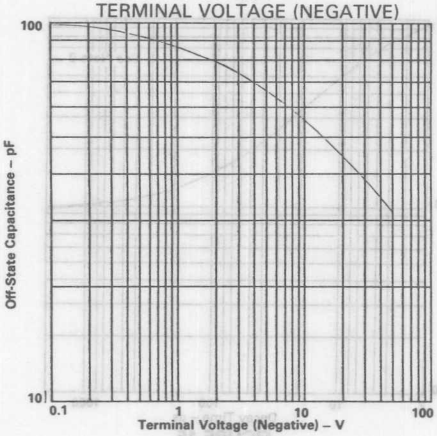


FIGURE 12

TYPICAL CHARACTERISTICS
for the A and B terminals

OFF-STATE CAPACITANCE
vs
TERMINAL VOLTAGE (POSITIVE)

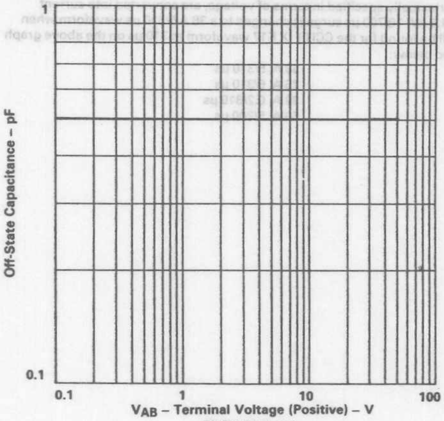


FIGURE 13

OFF-STATE CAPACITANCE
vs
TERMINAL VOLTAGE (NEGATIVE)

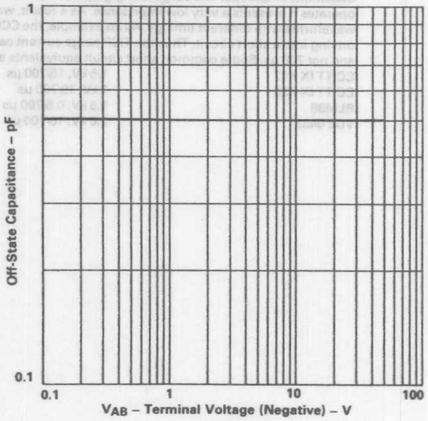


FIGURE 14

† Polarity is determined at terminal A or B with respect to C

TYPICAL CHARACTERISTICS

SURGE CURRENT
vs
DECAY TIME

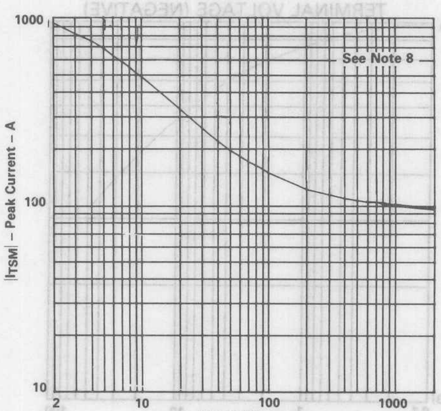


FIGURE 15

NOTE: 8. Most lightning tests, used for equipment verification, specify a unidirectional sawtooth waveform which has an exponential rise and an exponential decay. Waveforms will be specified in terms of a Peak Amplitude (voltage or current), rise time and a decay time to 50% of the maximum amplitude. The surge rating graph comprehends the rise times of commonly used surge waveforms. When the transient suppressor operates it presents a very low impedance. As a result, waveforms principally specified in terms of voltage, are converted into current waveforms with different timings. As an example, the CCITT IX K17 1.5 kV, 10/700 µs surge is changed to a 38 A 5/310 µs waveform when driving into a short circuit. Thus the TISP surge current capability will be found for the CCITT IX K17 waveform at 310 µs on the above graph and not 700 µs. Some common short circuit equivalents are tabulated below:

CCITT IX K17	1.5 kV, 10/700 µs	38 A, 5/310 µs
CCITT IX K20	1 kV, 10/700 µs	25 A, 5/310 µs
RLM88	1.5 kV, 0.5/700 µs	38 A, 0.2/310 µs
VDE 0433	2.0 kV, 10/700 µs	50 A, 5/200 µs

THERMAL INFORMATION

THERMAL RESPONSE

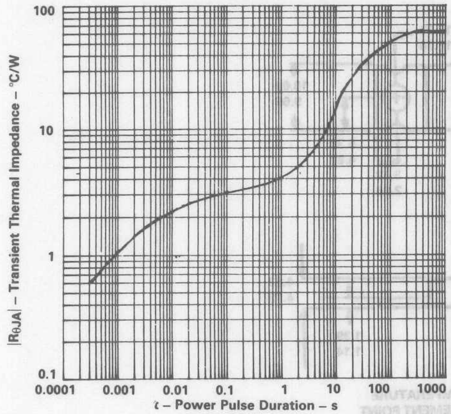


FIGURE 16

MAXIMUM NON-RECURRENT 50 Hz CURRENT
vs
CURRENT DURATION

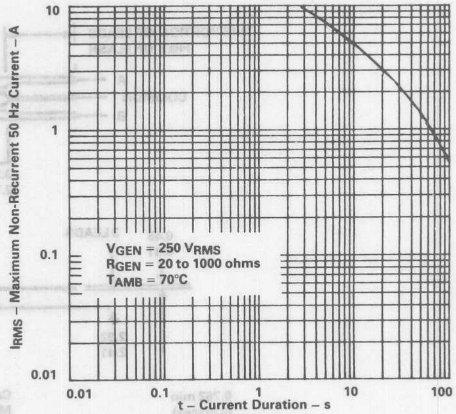


FIGURE 17

FREE AIR TEMPERATURE
DERATING CURVE

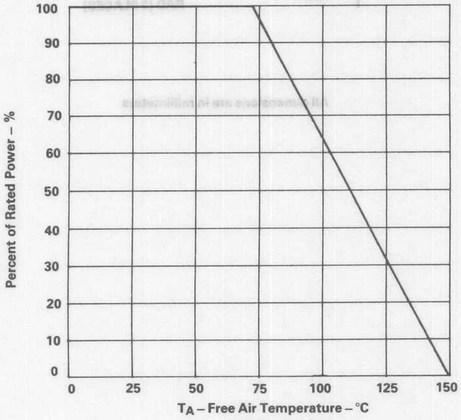
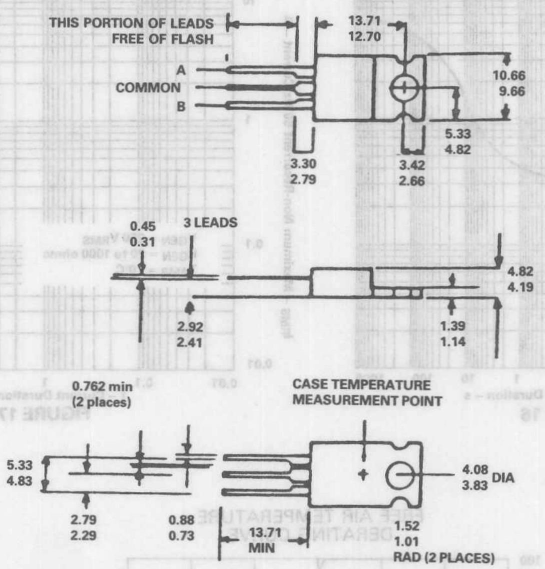


FIGURE 18

mechanical data

The centre pin is in electrical contact with the mounting tab



All dimensions are in millimeters

TISP4082
SYMMETRICAL TRANSIENT VOLTAGE SUPPRESSORS

APRIL 1987

FOR APPLICATIONS IN
TELECOMMUNICATIONS EQUIPMENT

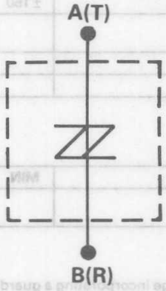
	TISP4082
• **Breakover Voltage, $V_{(BO)}$ Max**	**82 V**
• **Zener Voltage, V_Z Min**	**58 V**
• **Holding Current, I_H Min**	**150 mA**
• **Surge Rating:**	
ANSI	**150 A**
VDE0433	**2.0 kV**
RLM88	**1.5 kV**
CCITT IX K17	**1.5 kV**

The TISP4082 is designed specifically for telephone equipment protection against lightning and transients induced by ac power lines. These devices consist of a bidirectional suppressor element connecting the A and B terminals. They will suppress inter-wire voltage transients.

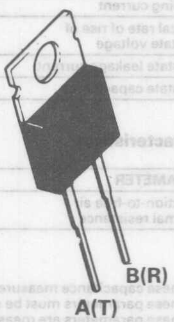
Transients are initially clipped by zener action until the voltage rises to the breakover lever, which causes the device to crowbar. The high crowbar holding current prevents de latchup as the transient subsides.

These monolithic protection devices are fabricated in ion-implanted planar structures to ensure precise and symmetrical breakover control.

device schematic



DO–220 PACKAGE



Pin A is in electrical contact with the mounting pad.

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TEXAS INSTRUMENTS

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TISP4082
SYMMETRICAL TRANSIENT VOLTAGE SUPPRESSORS

APRIL 1987

absolute maximum ratings at 25°C case temperature (unless otherwise noted)

RATING	SYMBOL		UNIT
Non-repetitive peak on-state pulse current			
8/20 µs (ANSI STD C62) (see notes 1,2)	I_{TSP}	150	A
5/200 µs (VDE0433 10/700 µs, 2kV) (see notes 1,2,3)	I_{TSP}	50	A
0.2/310 µs (RLM88 0.5/700 µs, 1.5kV) (see notes 1,2,3)	I_{TSP}	38	A
5/310 µs (CCITT IX K17 10/700 µs, 1.5kV) (See notes 1,2,3)	I_{TSP}	38	A
50 Hz RMS on-state current 2.5 s (see notes 1,2)	I_{TSM}	10	A
Initial rate of rise of on-state current	di_t/dt	250	A/µs
Junction temperature	T_{jmax}	150	°C
Operating free air temperature range		0–70	°C
Storage temperature range	T_{stg}	−40+150	°C
Lead temperature 1.5 mm from case for 10 s	T_{lead}	260	°C

NOTES: 1. Above 70°C, derate linearly to zero at 150°C case temperature.
2. This value applies when the initial case temperature is at (or below) 70°C. The surge may be repeated after the device has returned to thermal equilibrium.
3. Most PTT's quote an unloaded voltage waveform. In operation the TISP essentially shorts the generator output. The resulting loaded current waveform is specified.

electrical characteristics, $T_J = 25°C$

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_Z	Reference zener voltage	$I_Z = \pm 1$ mA	±58			V
α_{VZ}	Temperature coefficient of reference voltage			0.1		%/°C
$V_{(BO)}$	Breakover voltage	See Notes 5 and 6			±82	V
$I_{(BO)}$	Breakover Current	See Note 5	±0.15		±0.6	A
V_{TM}	Peak on-state voltage	$I_T = \pm 5A$ See Note 5 and 6		±2.2	±3	V
I_H	Holding current	See Note 5	±150			mA
dv/dt	Critical rate of rise of off state voltage	See Note 7			±5	kV/µs
I_D	Off-state leakage current	$V_D = \pm 50$ V			±10	µA
C_{off}	Off-state capacitance	$V_D = 0$, f= 1 kHz See Note 4		110	200	pF

thermal characteristics

	PARAMETER	MIN	TYP	MAX	UNIT
$R_{\theta JA}$	Junction-to-free air thermal resistance			62.5	°C/W

NOTES: 4. These capacitance measurements employ a three-terminal capacitance bridge incorporating a guard circuit.
5. These parameters must be measured using pulse techniques, $t_w = 100$ µs, duty cycle ≤2%.
6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.
7. Linear rate of rise, maximum voltage limited to 80% V_Z (minimum).

PARAMETER MEASUREMENT INFORMATION

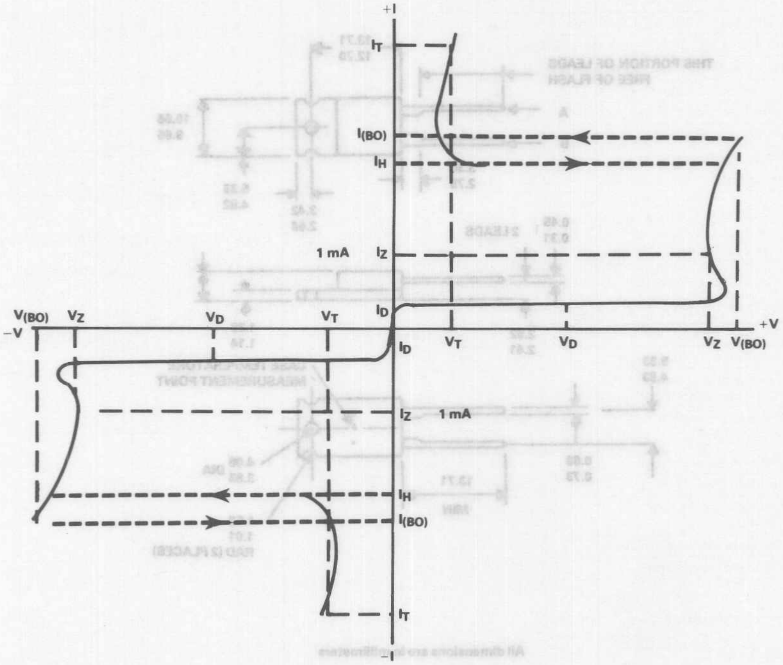
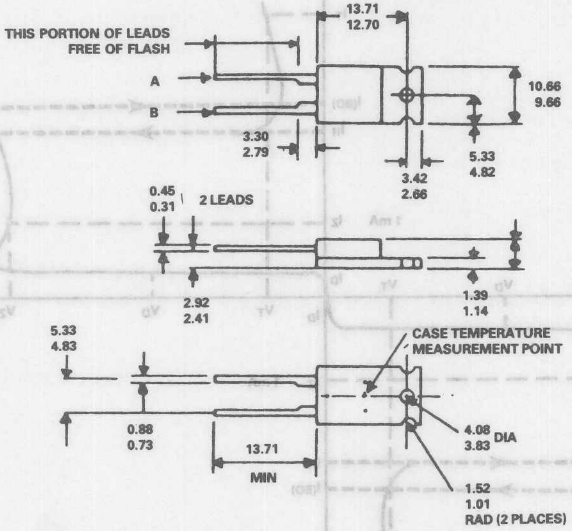


FIGURE 1. VOLTAGE-CURRENT CHARACTERISTICS FOR TERMINALS A AND B

mechanical data



All dimensions are in millimeters

TISP4180
SYMMETRICAL TRANSIENT VOLTAGE SUPPRESSORS

NOVEMBER 1986–REVISED APRIL 1987

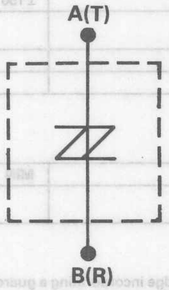
FOR APPLICATIONS IN TELECOMMUNICATIONS EQUIPMENT

The TISP4180 is designed specifically for telephone equipment protection against lightning and transients induced by ac power lines. These devices consist of a bidirectional suppressor element connecting the A and B terminals. They will suppress inter-wire voltage transients.

Transients are initially clipped by zener action until the voltage rises to the breakover lever, which causes the device to crowbar. The high crowbar holding current prevents de latchup as the transient subsides.

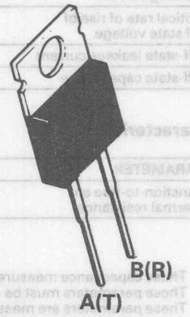
These monolithic protection devices are fabricated in ion-implanted planar structures to ensure precise and symmetrical breakover control.

device schematic



	TISP4180
• **Breakover Voltage, $V_{(BO)}$ Max**	**180 V**
• **Zener Voltage, V_Z Min**	**145 V**
• **Holding Current, I_H Min**	**150 mA**
• **Surge Rating:**	
ANSI	**150 A**
VDE0433	**2.0 kV**
RLM88	**1.5 kV**
CCITT IX K17	**1.5 kV**

DO–220 PACKAGE



Pin A is in electrical contact with the mounting pad.

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TISP4180
SYMMETRICAL TRANSIENT VOLTAGE SUPPRESSORS

NOVEMBER 1986–REVISED APRIL 1987

absolute maximum ratings at 25°C case temperature (unless otherwise noted)

RATING	SYMBOL		UNIT
Non-repetitive peak on-state pulse current			
8/20 µs (ANSI STD C62) (see notes 1,2)	I_{TSP}	150	A
5/200 µs (VDE0433 10/700µs, 2kV) (see notes 1,2,3)	I_{TSP}	50	A
0.2/310 µs (RLM88 0.5/700 µs, 1.5kV) (see notes 1,2,3)	I_{TSP}	38	A
5/310 µs (CCITT IX K17 10/700 µs, 1.5kV) (See notes 1,2,3)	I_{TSP}	38	A
50 Hz RMS on-state current 2.5 s (see notes 1,2)	I_{TSM}	10	A
Initial rate of rise of on-state current	di_t/dt	250	A/µs
Junction temperature	T_{jmax}	150	°C
Operating free air temperature range		0–70	°C
Storage temperature range	T_{stg}	−40+150	°C
Lead temperature 1.5 mm from case for 10 s	T_{lead}	260	°C

NOTES: 1. Above 70°C, derate linearly to zero at 150°C case temperature.
2. This value applies when the initial case temperature is at (or below) 70°C. The surge may be repeated after the device has returned to thermal equilibrium.
3. Most PTT's quote an unloaded voltage waveform. In operation the TISP essentially shorts the generator output. The resulting loaded current waveform is specified.

electrical characteristics, $T_J = 25°C$

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_Z	Reference zener voltage	$I_Z = \pm 1$ mA	±145			V
αVZ	Temperature coefficient of reference voltage			0.1		%/°C
$V_{(BO)}$	Breakover voltage	See Notes 5 and 6			±180	V
$I_{(BO)}$	Breakover Current	See Note 5	±0.15		±0.6	A
V_{TM}	Peak on-state voltage	$I_T = \pm 5A$ See Note 5 and 6		±2.2	±3	V
I_H	Holding current	See Note 5	±150			mA
dv/dt	Critical rate of rise of off state voltage	See Note 7			±5	kV/µs
I_D	Off-state leakage current	$V_D = \pm 50$ V			±10	µA
C_{off}	Off-state capacitance	$V_D = 0$, f= 1 kHz See Note 4		110	200	pF

thermal characteristics

	PARAMETER	MIN	TYP	MAX	UNIT
$R_{\theta JA}$	Junction-to-free air thermal resistance			62.5	°C/W

NOTES: 4. These capacitance measurements employ a three-terminal capacitance bridge incorporating a guard circuit.
5. These parameters must be measured using pulse techniques, $t_w = 100$ µs, duty cycle ≤2%.
6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.
7. Linear rate of rise, maximum voltage limited to 80% V_Z (minimum).

TEXAS INSTRUMENTS

PARAMETER MEASUREMENT INFORMATION

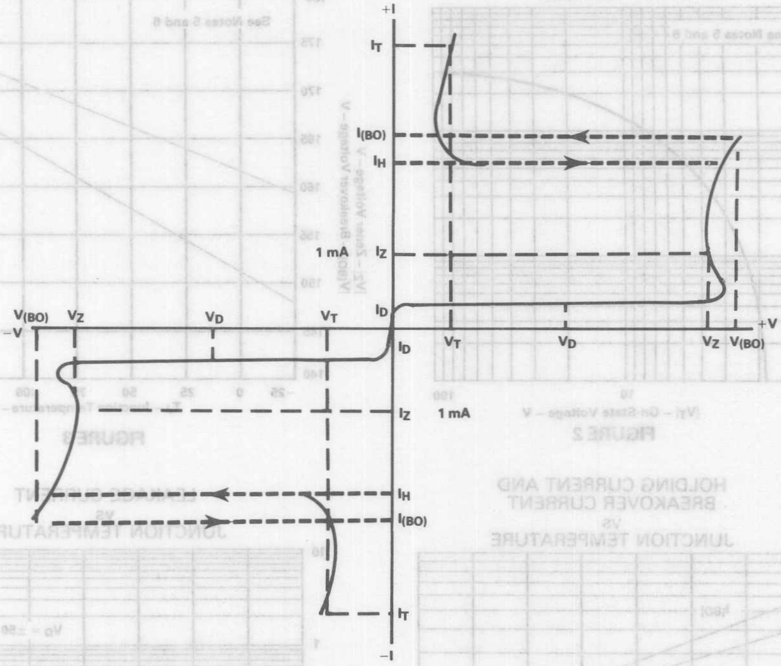


FIGURE 1. VOLTAGE-CURRENT CHARACTERISTICS FOR TERMINALS A AND B

TYPICAL CHARACTERISTICS for the A and B terminals

ON-STATE CURRENT
vs
ON-STATE VOLTAGE

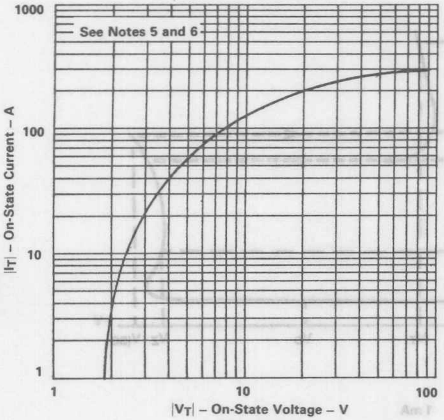


FIGURE 2

ZENER VOLTAGE AND BREAKOVER VOLTAGE
vs
JUNCTION TEMPERATURE

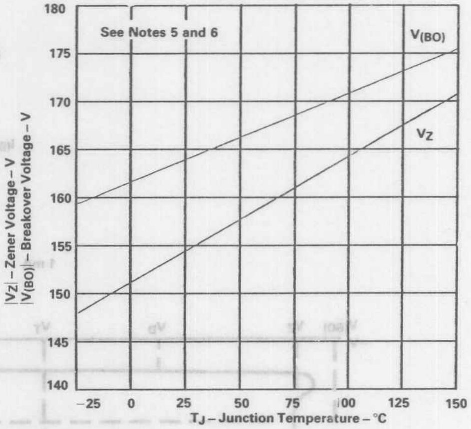


FIGURE 3

HOLDING CURRENT AND BREAKOVER CURRENT
vs
JUNCTION TEMPERATURE

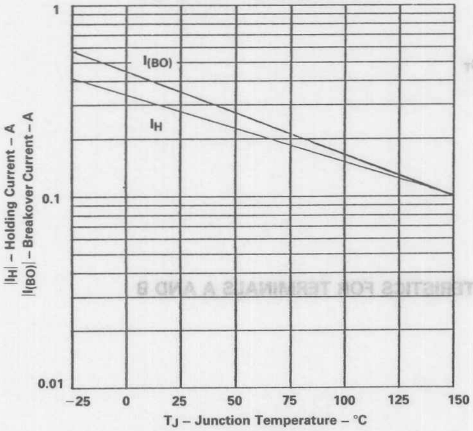


FIGURE 4

LEAKAGE CURRENT
vs
JUNCTION TEMPERATURE

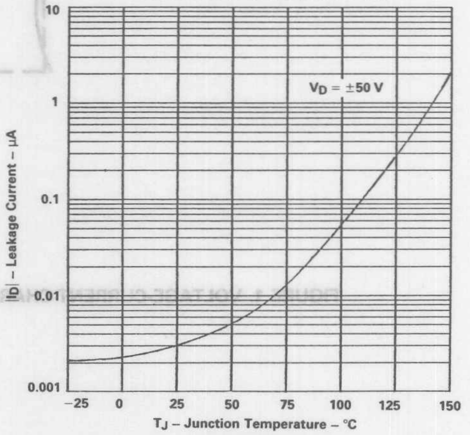


FIGURE 5

5. These parameters must be measured using pulse techniques, t_W = 100 μs, duty cycle ≤2%.
6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.

TYPICAL CHARACTERISTICS
for the A and B terminals

ON-STATE VOLTAGE
vs
JUNCTION TEMPERATURE

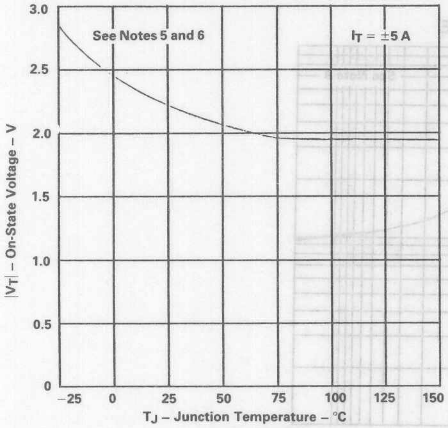


FIGURE 6

NORMALISED BREAKOVER VOLTAGE
vs
RATE OF RISE OF PRINCIPLE CURRENT

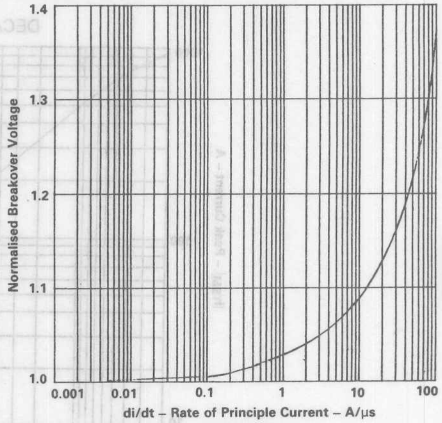


FIGURE 7

OFF-STATE CAPACITANCE
vs
A TERMINAL VOLTAGE (POSITIVE)

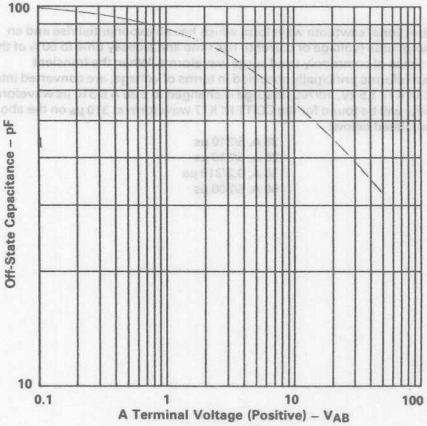


FIGURE 8

OFF-STATE CAPACITANCE
vs
A TERMINAL VOLTAGE (NEGATIVE)

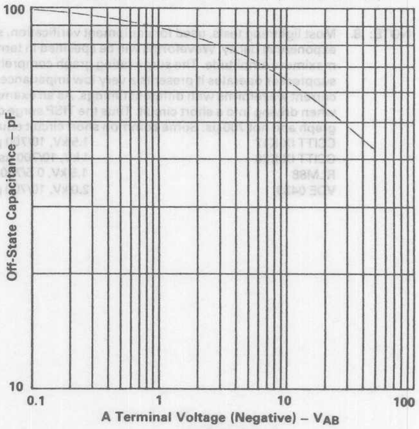


FIGURE 9

5. These parameters must be measured using pulse techniques, $t_w = 100$ μs, duty cycle ≤2%.
6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.

TYPICAL CHARACTERISTICS

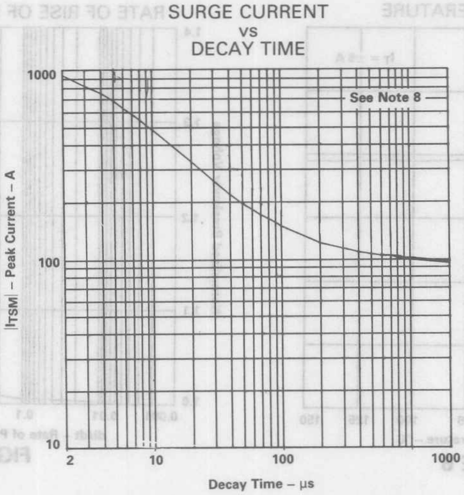


FIGURE 10

NOTE: 8. Most lightning tests, used for equipment verification, specify a unidirectional sawtooth waveform which has an exponential rise and an exponential decay. Waveforms will be specified in terms of a Peak Amplitude (voltage or current), rise time and a decay time to 50% of the maximum amplitude. The surge rating graph comprehends the rise times of commonly used surge waveforms. When the transient suppressor operates it presents a very low impedance. As a result, waveforms principally specified in terms of voltage, are converted into current waveforms with different timings. As an example, the CCITT IX K17 1.5 kV, 10/700 µs surge is changed to a 38 A 5/310 µs waveform when driving into a short circuit. Thus the TISP surge current capability will be found for the CCITT IX K17 waveform at 310 µs on the above graph and not 700 µs. Some common short circuit equivalents are tabulated below:

CCITT IX K17	1.5 kV, 10/700 µs	38 A, 5/310 µs
CCITT IX K20	1 kV, 10/700 µs	25 A, 5/310 µs
RLM88	1.5 kV, 0.5/700 µs	38 A, 0.2/310 µs
VDE 0433	2.0 kV, 10/700 µs	50 A, 5/200 µs

THERMAL INFORMATION

THERMAL RESPONSE

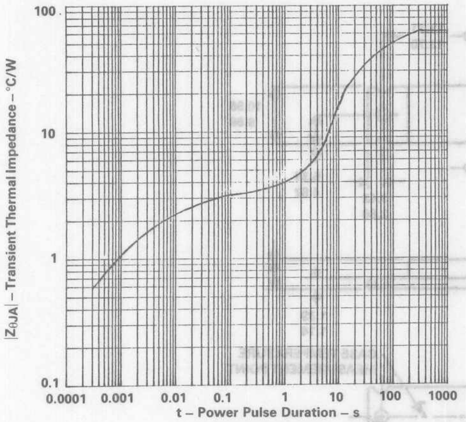


FIGURE 11

MAXIMUM NON-RECURRENT 50 Hz CURRENT vs CURRENT DURATION

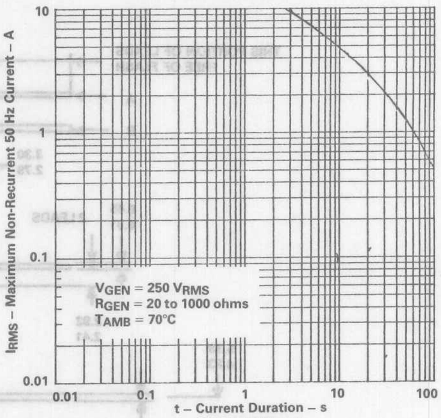


FIGURE 12

FREE AIR TEMPERATURE DERATING CURVE

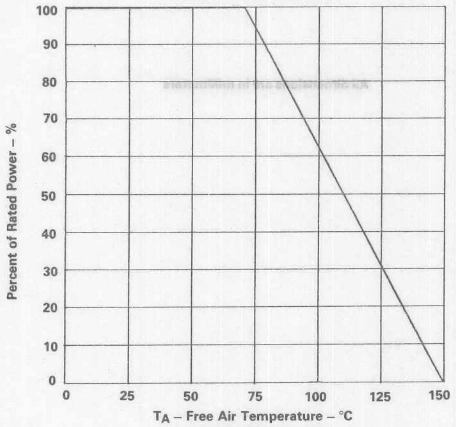
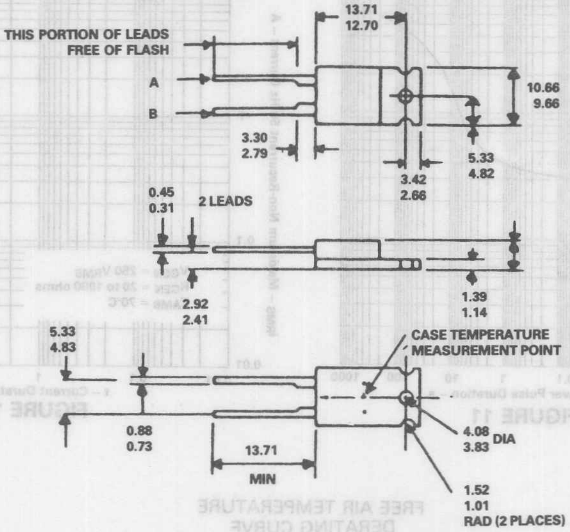


FIGURE 13

mechanical data



All dimensions are in millimeters

TISP5160
SYMMETRICAL TRANSIENT VOLTAGE SUPPRESSORS

APRIL 1987

FOR APPLICATIONS IN
TELECOMMUNICATIONS EQUIPMENT

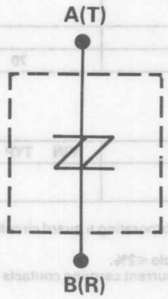
The TISP5160 is designed specifically for telephone equipment protection against lightning and transients induced by ac power lines. These devices consist of a bidirectional suppressor element connecting the A and B terminals. They will suppress inter-wire voltage transients.

Transients are initially clipped by zener action until the voltage rises to the breakover level, which causes the device to crowbar. The high crowbar holding current prevents dc latchup as the transient subsides.

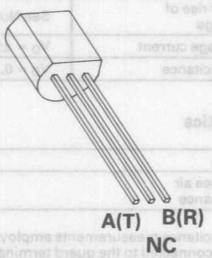
These monolithic protection devices are fabricated in ion-implanted planar structures to ensure precise and symmetrical breakover control.

• **Breakover Voltage, $V_{(BO)}$ Max**	**160 V**
• **Zener Voltage, V_Z Min**	**120 V**
• **Holding Current, I_H Min**	**150 mA**
• **Surge Rating:**	
ANSI	**100 A**
VDE0433	**2.0 kV**
RLM88	**1.5 kV**
CCITT IX K17	**1.5 kV**

device schematic



TO–92 PACKAGE



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TEXAS INSTRUMENTS

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absolute maximum ratings at 25°C case temperature (unless otherwise noted)

RATING	SYMBOL		UNIT
Non-repetitive peak on-state pulse current			
8/20 µs (ANSI STD C62) (see notes 1,2)	I_{TSP}	100	A
5/200 µs (VDE0433 10/700 µs, 2kV) (see notes 1,2,3)	I_{TSP}	50	A
0.2/310 µs (RLM88 0.5/700 µs, 1.5kV) (see notes 1,2,3)	I_{TSP}	38	A
5/310 µs (CCITT IX K17 10/700 µs, 1.5kV) (See notes 1,2,3)	I_{TSP}	38	A
50 Hz RMS on-state current 1 s (see notes 1,2)	I_{TSM}	2.5	A
Initial rate of rise of on-state current	di_T/dt	250	A/µs
Junction temperature	T_{jmax}	150	°C
Operating free air temperature range		0–70	°C
Storage temperature range	T_{stg}	−40+150	°C
Lead temperature 1.5 mm from case for 10 s	T_{lead}	260	°C

NOTES: 1. Above 70°C, derate linearly to zero at 150°C case temperature.
2. This value applies when the initial case temperature is at (or below) 70°C. The surge may be repeated after the device has returned to thermal equilibrium.
3. Most PTT's quote an unloaded voltage waveform. In operation the TISP essentially shorts the generator output. The resulting loaded current waveform is specified.

electrical characteristics, $T_j = 25°C$

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_Z	Reference zener voltage	$I_Z = \pm 1$ mA	±120			V
α_{VZ}	Temperature coefficient of reference voltage			0.1		%/°C
$V_{(BO)}$	Breakover voltage	See Notes 5 and 6			±160	V
$I_{(BO)}$	Breakover Current	See Note 5	±0.15		±0.6	A
V_{TM}	Peak on-state voltage	$I_T = \pm 5A$ See Note 5 and 6		±2.2	±3	V
I_H	Holding current	See Note 5	±150			mA
dv/dt	Critical rate of rise of off state voltage	See Note 7			±5	kV/µs
I_D	Off-state leakage current	$V_D = \pm 50$ V			±10	µA
C_{off}	Off-state capacitance	$V_D = 0$, f= 1 kHz See Note 4		70	150	pF

thermal characteristics

	PARAMETER	MIN	TYP	MAX	UNIT
$R_{\theta JA}$	Junction-to-free air thermal resistance			156	°C/W

NOTES: 4. These capacitance measurements employ a three-terminal capacitance bridge incorporating a guard circuit. The third terminal is connected to the guard terminal of the bridge.
5. These parameters must be measured using pulse techniques, $t_w = 100$ µs, duty cycle ≤2%.
6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.
7. Linear rate of rise, maximum voltage limited to 80% V_Z (minimum).

PARAMETER MEASUREMENT INFORMATION

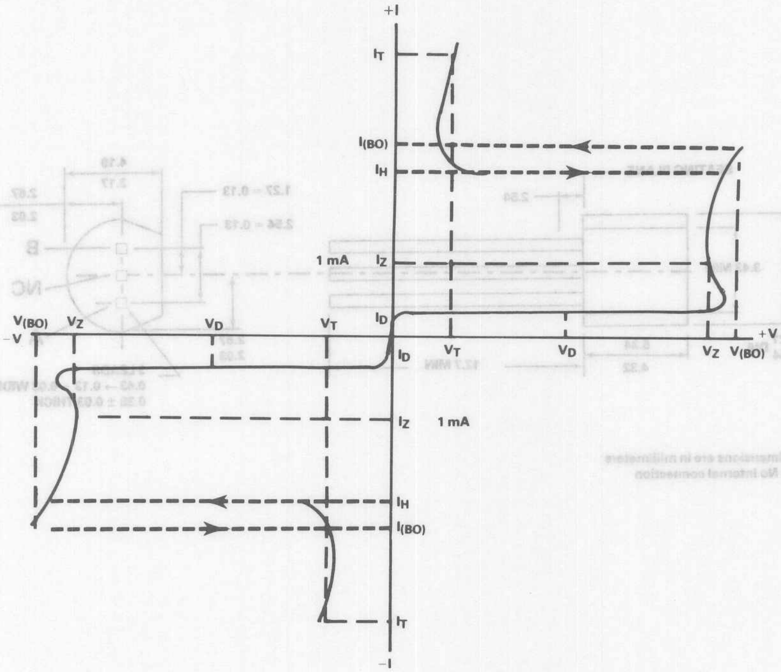
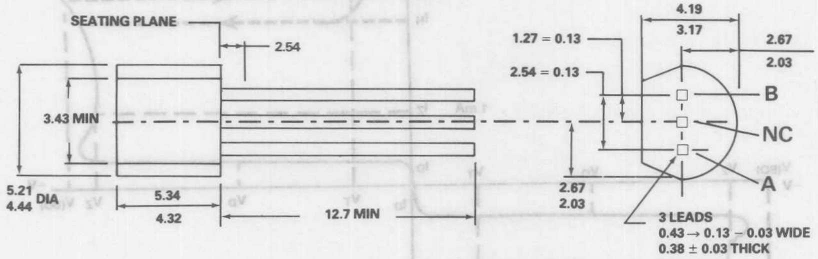


FIGURE 1. VOLTAGE-CURRENT CHARACTERISTICS FOR TERMINALS A AND B

mechanical data



All dimensions are in millimeters
NC – No internal connection

TISP5180
SYMMETRICAL TRANSIENT VOLTAGE SUPPRESSORS

APRIL 1987

FOR APPLICATIONS IN TELECOMMUNICATIONS EQUIPMENT

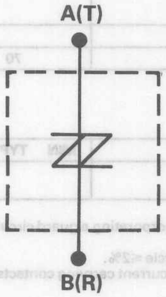
The TISP5180 is designed specifically for telephone equipment protection against lightning and transients induced by ac power lines. These devices consist of a bidirectional suppressor element connecting the A and B terminals. They will suppress inter-wire voltage transients.

Transients are initially clipped by zener action until the voltage rises to the breakover level, which causes the device to crowbar. The high crowbar holding current prevents dc latchup as the transient subsides.

These monolithic protection devices are fabricated in ion-implanted planar structures to ensure precise and symmetrical breakover control.

• **Breakover Voltage, $V_{(BO)}$ Max**	**180 V**
• **Zener Voltage, V_Z Min**	**145 V**
• **Holding Current, I_H Min**	**150 mA**
• **Surge Rating:**	
ANSI	**100 A**
VDE0433	**2.0 kV**
RLM88	**1.5 kV**
CCITT IX K17	**1.5 kV**

device schematic



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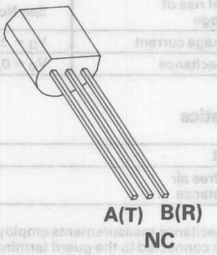

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TISP5180
SYMMETRICAL TRANSIENT VOLTAGE SUPPRESSORS

APRIL 1987

absolute maximum ratings at 25°C case temperature (unless otherwise noted)

RATING	SYMBOL		UNIT
Non-repetitive peak on-state pulse current			
8/20 µs (ANSI STD C62) (see notes 1,2)	I_{TSP}	100	A
5/200 µs (VDE0433 10/700 µs, 2kV) (see notes 1,2,3,)	I_{TSP}	50	A
0.2/310 µs (RLM88 0.5/700 µs, 1.5kV) (see notes 1,2,3)	I_{TSP}	38	A
5/310 µs (CCITT IX K17 10/700 µs, 1.5kV) (See notes 1,2,3)	I_{TSP}	38	A
50 Hz RMS on-state current 1 s (see notes 1,2)	I_{TSM}	2.5	A
Initial rate of rise of on-state current	di_t/dt	250	A/µs
Junction temperature	T_{jmax}	150	°C
Operating free air temperature range		0–70	°C
Storage temperature range	T_{stg}	−40+150	°C
Lead temperature 1.5 mm from case for 10 s	T_{lead}	260	°C

NOTES: 1. Above 70°C, derate linearly to zero at 150°C case temperature.
2. This value applies when the initial case temperature is at (or below) 70°C. The surge may be repeated after the device has returned to thermal equilibrium.
3. Most PTT's quote an unloaded voltage waveform. In operation the TISP essentially shorts the generator output. The resulting loaded current waveform is specified.

electrical characteristics, $T_j = 25°C$

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_Z	Reference zener voltage	$I_Z = \pm 1$ mA	±145			V
α_{VZ}	Temperature coefficient of reference voltage			0.1		%/°C
$V_{(BO)}$	Breakover voltage	See Notes 5 and 6			±180	V
$I_{(BO)}$	Breakover Current	See Note 5	±0.15		±0.6	A
V_{TM}	Peak on-state voltage	$I_T = \pm 5$A See Note 5 and 6		±2.2	±3	V
I_H	Holding current	See Note 5	±150			mA
dv/dt	Critical rate of rise of off state voltage	See Note 7			±5	kV/µs
I_D	Off-state leakage current	$V_D = \pm 50$ V			±10	µA
C_{off}	Off-state capacitance	$V_D = 0$, f= 1 kHz See Note 4		70	150	pF

thermal characteristics

	PARAMETER	MIN	TYP	MAX	UNIT
$R_{\theta JA}$	Junction-to-free air thermal resistance			156	°C/W

NOTES: 4. These capacitance measurements employ a three-terminal capacitance bridge incorporating a guard circuit. The third terminal is connected to the guard terminal of the bridge.
5. These parameters must be measured using pulse techniques, $t_w = 100$ µs, duty cycle ≤2%.
6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.
7. Linear rate of rise, maximum voltage limited to 80% V_Z (minimum).

PARAMETER MEASUREMENT INFORMATION

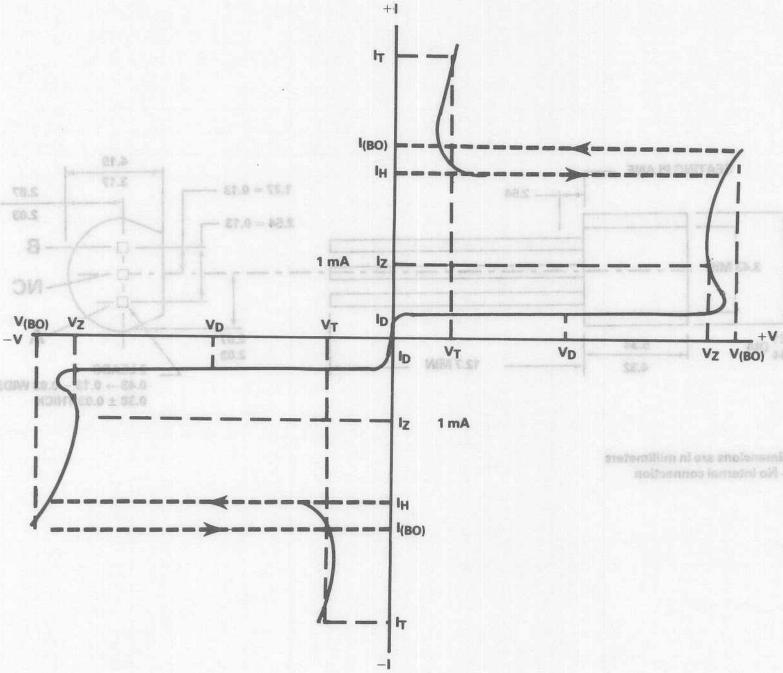
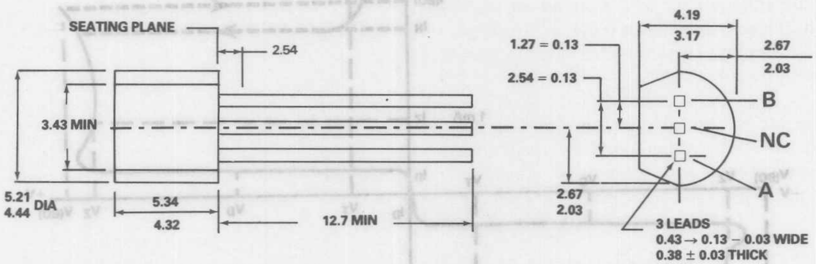


FIGURE 1. VOLTAGE-CURRENT CHARACTERISTICS FOR TERMINALS A AND B

mechanical data



All dimensions are in millimeters
NC – No internal connection

TISP5290
SYMMETRICAL TRANSIENT VOLTAGE SUPPRESSORS

APRIL 1987

FOR APPLICATIONS IN
TELECOMMUNICATIONS EQUIPMENT

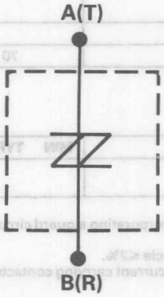
The TISP5290 is designed specifically for telephone equipment protection against lightning and transients induced by ac power lines. These devices consist of a bidirectional suppressor element connecting the A and B terminals. They will suppress inter-wire voltage transients.

Transients are initially clipped by zener action until the voltage rises to the breakover level, which causes the device to crowbar. The high crowbar holding current prevents dc latchup as the transient subsides.

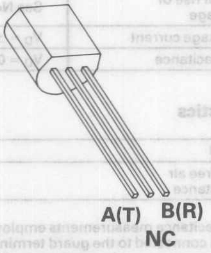
These monolithic protection devices are fabricated in ion-implanted planar structures to ensure precise and symmetrical breakover control.

• **Breakover Voltage, $V_{(BO)}$ Max**	**290 V**
• **Zener Voltage, V_Z Min**	**200 V**
• **Holding Current, I_H Min**	**150 mA**
• **Surge Rating:**	
ANSI	**150 A**
VDE0433	**2.0 kV**
RLM88	**1.5 kV**
CCITT IX K17	**1.5 kV**

device schematic



TO–92 PACKAGE



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TISP5290
SYMMETRICAL TRANSIENT VOLTAGE SUPPRESSORS

APRIL 1987

absolute maximum ratings at 25°C case temperature (unless otherwise noted)

RATING	SYMBOL		UNIT
Non-repetitive peak on-state pulse current			
8/20 µs (ANSI STD C62) (see notes 1,2)	I_{TSP}	150	A
5/200 µs (VDE0433 10/700 µs, 2kV) (see notes 1,2,3)	I_{TSP}	50	A
0.2/310 µs (RLM88 0.5/700 µs, 1.5kV) (see notes 1,2,3)	I_{TSP}	38	A
5/310 µs (CCITT IX K17 10/700 µs, 1.5kV) (See notes 1,2,3)	I_{TSP}	38	A
50 Hz RMS on-state current 1 s (see notes 1,2)	I_{TSM}	2.5	A
Initial rate of rise of on-state current	di_t/dt	250	A/µs
Junction temperature	T_{jmax}	150	°C
Operating free air temperature range		0–70	°C
Storage temperature range	T_{stg}	-40+150	°C
Lead temperature 1.5 mm from case for 10 s	T_{lead}	260	°C

NOTES: 1. Above 70°C, derate linearly to zero at 150°C case temperature.
2. This value applies when the initial case temperature is at (or below) 70°C. The surge may be repeated after the device has returned to thermal equilibrium.
3. Most PTT's quote an unloaded voltage waveform. In operation the TISP essentially shorts the generator output. The resulting loaded current waveform is specified.

electrical characteristics, $T_j = 25°C$

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_Z	Reference zener voltage	$I_Z = \pm 1$ mA	±200			V
α_{VZ}	Temperature coefficient of reference voltage			0.1		%/°C
$V_{(BO)}$	Breakover voltage	See Notes 5 and 6			±290	V
$I_{(BO)}$	Breakover Current	See Note 5	±0.15		±0.6	A
V_{TM}	Peak on-state voltage	$I_T = \pm 5$A See Note 5 and 6		±2.2	±3	V
I_H	Holding current	See Note 5	±150			mA
dv/dt	Critical rate of rise of off state voltage	See Note 7			±5	kV/µs
I_D	Off-state leakage current	$V_D = \pm 50$ V			±10	µA
C_{off}	Off-state capacitance	$V_D = 0$, f= 1 kHz See Note 4		70	150	pF

thermal characteristics

	PARAMETER	MIN	TYP	MAX	UNIT
$R_{\theta JA}$	Junction-to-free air thermal resistance			156	°C/W

NOTES: 4. These capacitance measurements employ a three-terminal capacitance bridge incorporating a guard circuit. The third terminal is connected to the guard terminal of the bridge.
5. These parameters must be measured using pulse techniques, $t_w = 100$ µs, duty cycle ≤2%.
6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.
7. Linear rate of rise, maximum voltage limited to 80% V_Z (minimum).

PARAMETER MEASUREMENT INFORMATION

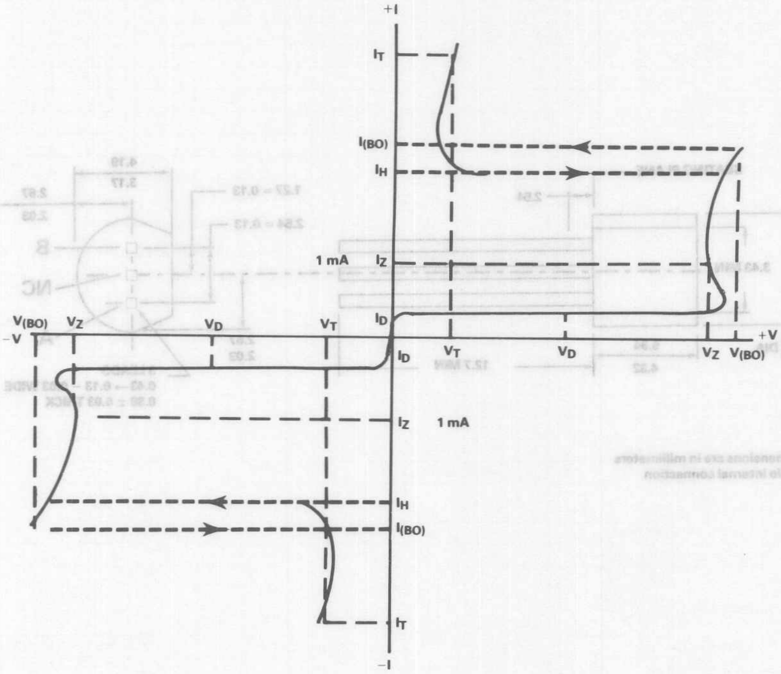
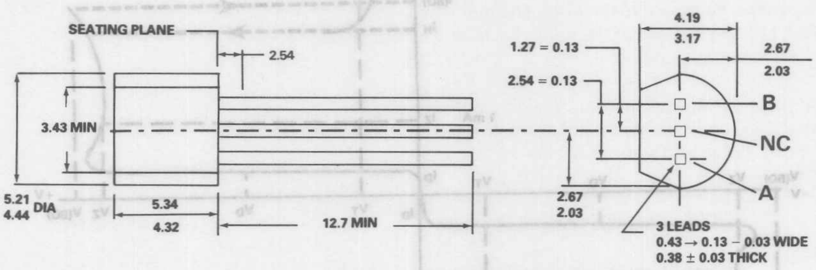


FIGURE 1. VOLTAGE-CURRENT CHARACTERISTICS FOR TERMINALS A AND B

mechanical data



All dimensions are in millimeters
NC – No internal connection

ADVANCE INFORMATION

TISP7180, TISP7290, DUAL SYMMETRICAL TRANSIENT VOLTAGE SUPPRESSORS

APRIL 1987

FOR APPLICATIONS IN TELECOMMUNICATIONS EQUIPMENT

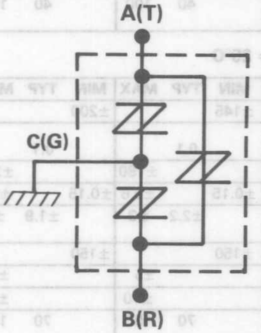
The TISP7000 series is designed specifically for telephone equipment protection against lightning and transients induced by ac power lines. These devices will suppress voltage transients between terminals A and C, B and C, and A and B.

Transients are initially clipped by zener action until the voltage rises to the breakover level which causes the device to crowbar. The high crowbar holding current prevents dc latchup as the transient subsides.

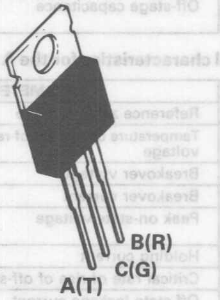
These monolithic protection devices are fabricated in ion-implanted planar structures to ensure precise and symmetrical breakover control.

	TISP7180	TISP7290
• Breakover Voltage, $V_{(BO)}$ Max	180 V	290 V
• Zener Voltage, V_Z Min	145 V	200 V
• Holding Current, I_H Min	150 mA	
• Surge Rating:		
ANSI	100 A	150 A
VDE0433	2.0 kV	
RLM88	1.5 kV	
CCITT IX K17	1.5 kV	

device schematic



TO-220 PACKAGE



Pin C is in electrical contact with the mounting pad

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TEXAS INSTRUMENTS

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TISP7180, TISP7290
DUAL SYMMETRICAL TRANSIENT VOLTAGE SUPPRESSORS

APRIL 1987

absolute maximum rating at 25°C case temperature (unless otherwise noted)

RATING	SYMBOL		UNIT
Non-repetitive peak on-state pulse current			
8/20 µs (ANSI STD C62) (see notes 1, 2)	I_{TSP}	100/150	A
5/200 µs (VDE0433 10/700 µs, 2kV) (see notes 1, 2, 3)	I_{TSP}	50	A
0.2/310 µs (RLM88 0.5/700 µs 1.5kV) (see notes 1, 2, 3)	I_{TSP}	38	A
5/310 µs((CCITT IX K17 10/700 µs 1.5kV) (see notes 1, 2, 3)	I_{TSP}	38	A
50 Hz RMS on-state current 2.5 s (see notes 1, 2)	I_{TSM}	10	A
Initial rate of rise of on-state current	di_t/dt	250	A/µs
Junction temperature	T_{jmax}	150	°C
Operating free air temperature range		0-70	°C
Storage temperature range	T_{stg}	−40+150	°C
Lead temperature 1.5mm from case for 10 s	T_{lead}	260	°C

NOTES: 1. Above 70°C, derate linearly to zero at 150°C case temperature.

2. This value applies when the initial case temperature is at (or below) 70°C. The surge may be repeated after the device has returned to thermal equilibrium.

3. Most PTT's quote an unloaded voltage waveform. In operation the TISP essentially shorts the generator output. The resulting loaded current waveform is specified.

electrical characteristics for the A and B terminals, $T_j = 25°C$

	PARAMETER	TEST CONDITIONS	TISP7180			TISP7290			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V_Z	Reference zener voltage	I_Z = ±1 mA	±145			±200			V
I_D	Off-stage leakage current	V_D = ±50 V			±10			±10	µA
C_{off}	Off-stage capacitance	V_D = 0, f = 1 kHz See Note 4		40	100		40	100	pF

electrical characteristics for the A and C or the B and C terminals, $T_J = 25°C$

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
V_Z	Reference zener voltage	I_Z = ±1 mA	±145			±200			V
$\propto_{VZ}$	Temperature coefficient of reference voltage			0.1			0.1		%/°C
$V_{(BO)}$	Breakover voltage	See Notes 5 and 6			±180			±290	V
$I_{(BO)}$	Breakover current	See Note 5	±0.15		±0.6	±0.15		±0.6	A
V_{TM}	Peak on-state voltage	I_T = ±5 A See Notes 5 and 6		±2.2	±3		±1.9	±3	V
I_H	Holding current	See Note 5	±150			±150			mA
dv/dt	Critical rate of rise of off-state voltage	See Note 7			±5			±5	kV/µs
I_D	Off-state leakage current	V_D = ±50 V			±10			±10	µA
C_{off}	Off-state capacitance	V_D = 0, f = 1 kHz See Note 4		70	150		70	150	pF

thermal characteristics

	PARAMETER	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
$R_{\theta}JA$	Junction-to-free-air thermal resistance			62.5			62.5	°C/W

NOTES: 4. These capacitance measurements employ a three-terminal capacitance bridge incorporating a guard circuit. The third terminal is connected to the guard terminal of the bridge.

5. These parameters must be measured using pulse techniques, t_w = 100 µs duty cycle ≤2%.

6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.

7. Linear rate of rise, maximum voltage limited to 80% V_Z (minimum).

PARAMETER MEASUREMENT INFORMATION

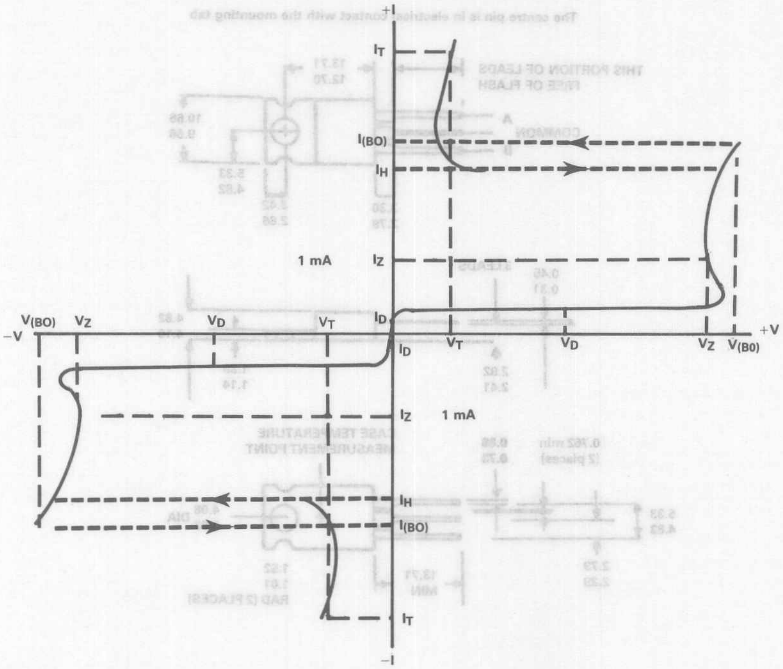
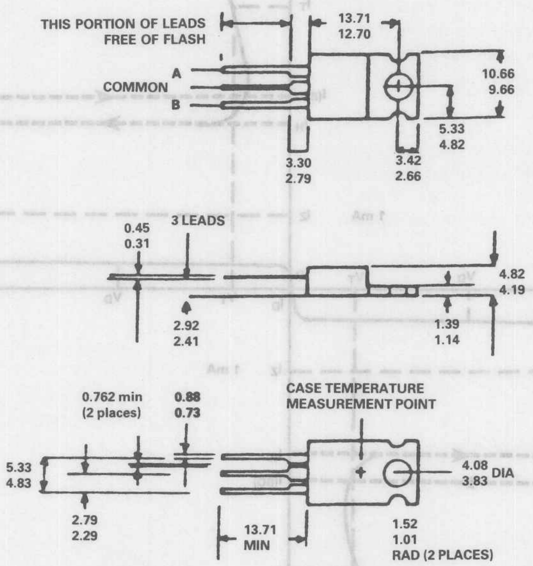


FIGURE 1. VOLTAGE-CURRENT CHARACTERISTICS FOR ANY PAIR OF TERMINALS
The high level characteristics for terminals A and B are not guaranteed.

mechanical data

The centre pin is in electrical contact with the mounting tab



All dimensions are in millimeters

TISP8180/TISP8290
DUAL SYMMETRICAL TRANSIENT VOLTAGE SUPPRESSORS

APRIL 1987

FOR APPLICATIONS IN
TELECOMMUNICATIONS EQUIPMENT

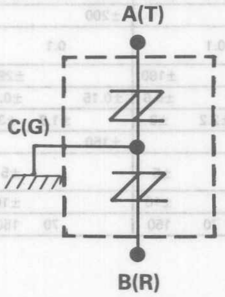
The TISP8000 series is designed specifically for telephone equipment protection against lightning and transients induced by ac power lines. These devices consist of two bidirectional suppressor elements connected to a Common (C) terminal. They will suppress voltage transients between terminals A and C, B and C, and A and B.

Transients are initially clipped by zener action until the voltage rises to the breakover level, which causes the device to crowbar. The high crowbar holding current presents dc latchup as the transient subsides.

These monolothic protection devices are fabricated in ion-implanted planar structures to ensure precise and symmetrical breakover control.

	TISP8180	TISP8290
• **Breakover Voltage, $V_{(BO)}$ Max**	**180 V**	**290 V**
• **Zener Voltage, V_Z Min**	**145 V**	**200 V**
• **Holding Current, I_H Min**	**150 mA**	
• **Surge Rating:**		
ANSI	**100 A**	**150 A**
VDE0433	**2.0 kV**	
RLM88	**1.5 kV**	
CCITT IX K17	**1.5 kV**	

device schematic



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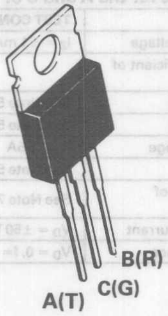

Pin C is in electrical contact with the mounting pad.

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TEXAS INSTRUMENTS

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absolute maximum rating at 25°C case temperature (unless otherwise noted)

RATING	SYMBOL		UNIT
Non-repetitive peak on-state pulse current			
8/20 µs (ANSI STD C62) (see notes 1,2)	I_{TSP}	100/150	A
5/200 µs (VDE0433 10/700 µs, 2kV) (see notes 1,2,3)	I_{TSP}	50	A
0.2/310 µs (RLM88 0.5/700 µs, 1.5kV) (see notes 1,2,3)	I_{TSP}	38	A
5/310 µs (CCITT IX K17 10/700 µs, 1.5kV) (See notes 1,2,3)	I_{TSP}	38	A
50 Hz RMS on-state current 2.5 s (see notes 1,2)	I_{TSM}	10	A
Initial rate of rise of on-state current	di_t/dt	250	A/µs
Junction temperature	T_{jmax}	150	°C
Operating free air temperature range		0–70	°C
Storage temperature range	T_{stg}	−40+150	°C
Lead temperature 1.5 mm from case for 10 s	T_{lead}	260	°C

NOTES: 1. Above 70°C, derate linearly to zero at 150°C case temperature.
2. This value applies when the initial case temperature is at (or below) 70°C. The surge may be repeated after the device has returned to thermal equilibrium.
3. Most PTT's quote an unloaded voltage waveform. In operation the TISP essentially shorts the generator output. The resulting loaded current waveform is specified.

electrical characteristics for the A and C or the B and C terminals, $T_j = 25°C$

			TISP8180			TISP8290			
	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
V_Z	Reference zener voltage	$I_Z = \pm 1$ mA	±290			±400			V
I_D	Off-state leakage current	$V_D = \pm 50$ V			±10			±10	µA
C_{off}	Off-state capacitance	$V_D = 0$, f = 1 kHz See note 4		0.5	5		0.5	5	pF

electrical characteristics for the A and C or the B and C terminals, $T_J = 25°C$

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
V_Z	Reference zener voltage	$I_Z = \pm 1$ mA	±145			±200			V
$^{\alpha}VZ$	Temperature coefficient of reference voltage			0.1			0.1		%/°C
$V_{(BO)}$	Breakover voltage	See Note 5 and 6			±180			±290	V
$I_{(BO)}$	Breakover Current	See Note 5	±0.15		±0.6	±0.15		±0.6	A
V_{TM}	Peak on-state voltage	$I_T = \pm 5$A See Note 5 and 6		±2.2	±3		±1.9	±3	V
I_H	Holding current	See Note 5	±150			±150			mA
dv/dt	Critical rate of rise of off state voltage	See Note 7			±5			±5	kV/µs
I_D	Off-state leakage current	$V_D = \pm 50$ V			±10			±10	µA
C_{off}	Off-state capacitance	$V_D = 0$, f= 1 kHz See Note 4		70	150		70	150	pF

thermal characteristics

	PARAMETER	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
$R_{\theta JA}$	Junction-to-free air thermal resistance			62.5			62.5	°C/W

NOTES: 4. These capacitance measurements employ a three-terminal capacitance bridge incorporating a guard circuit. The third terminal is connected to the guard terminal of the bridge.
5. These parameters must be measured using pulse techniques, $t_w = 100$ µs, duty cycle ≤2%.
6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.
7. Linear rate of rise, maximum voltage limited to 80% V_Z (minimum).

PARAMETER MEASUREMENT INFORMATION

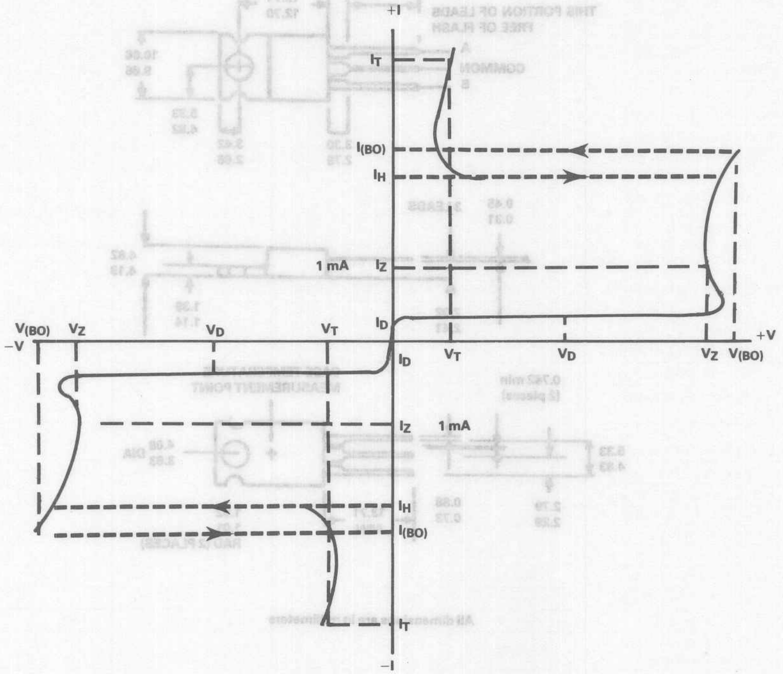
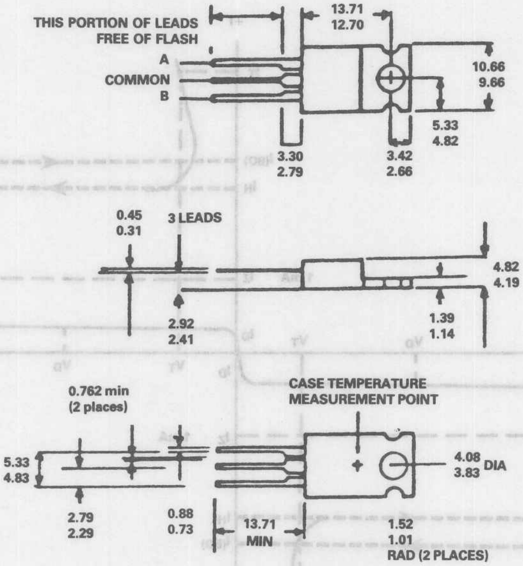


FIGURE 1. VOLTAGE-CURRENT CHARACTERISTICS FOR TERMINALS A AND C OR B AND C

mechanical data

The centre pin is in electrical contact with the mounting tab



All dimensions are in millimeters

TISP9180/TISP9290
SYMMETRICAL TRANSIENT VOLTAGE SUPPRESSORS

APRIL 1987

	TISP9180	TISP9290
• **Breakover Voltage, $V_{(BO)}$ Max**	180 V	290 V
• **Zener Voltage, V_Z Min**	145 V	200 V
• **Holding Current, I_H Min**	150 mA	
• **Surge Rating:**		
ANSI	100 A	150 A
VDE0433	2.0 kV	
RLM88	1.5 kV	
CCITT IX K17	1.5 kV	

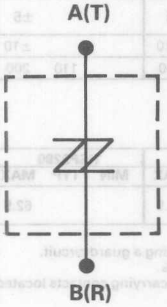
FOR APPLICATIONS IN TELECOMMUNICATIONS EQUIPMENT

The TISP9000 series is designed specifically for telephone equipment protection against lightning and transients induced by ac power lines. These devices consist of a bidirectional suppressor element connecting the A and B terminals. They will suppress inter-wire voltage transients.

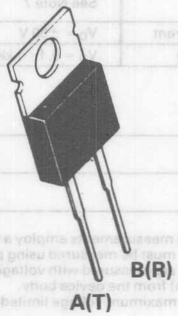
Transients are initially clipped by zener action until the voltage rises to the breakover level, which causes the device to crowbar. The high crowbar holding current prevents dc latchup as the transient subsides.

These monolithic protection devices are fabricated in ion-implanted planar structures to ensure precise and symmetrical breakover control.

device schematic



DO–220 PACKAGE



Pin A is in electrical contact with the mounting pad.

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TEXAS INSTRUMENTS

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absolute maximum ratings at 25°C case temperature (unless otherwise noted)

RATING	SYMBOL		UNIT
Non-repetitive peak on-state pulse current			
8/20 µs (ANSI STD C62) (see notes 1,2)	I_{TSP}	100/150	A
5/200 µs (VDE0433 10/700 µs, 2kV) (see notes 1,2,3)	I_{TSP}	50	A
0.2/310 µs (RML88 0.5/700 µs, 1.5kV) (see notes 1,2,3)	I_{TSP}	38	A
5/310 µs (CCITT IX K17 10/700 µs, 1.5kV) (See notes 1,2,3)	I_{TSP}	38	A
50 Hz RMS on-state current 2.5 s (see notes 1,2)	I_{TSM}	10	A
Initial rate of rise of on-state current	di_t/dt	250	A/µs
Junction temperature	T_{jmax}	150	°C
Operating free air temperature range		0–70	°C
Storage temperature range	T_{stg}	−40+150	°C
Lead temperature 1.5 mm from case for 10 s	T_{lead}	260	°C

NOTES: 1. Above 70°C, derate linearly to zero at 150°C case temperature.
2. This value applies when the initial case temperature is at (or below) 70°C. The surge may be repeated after the device has returned to thermal equilibrium.
3. Most PTT's quote an unloaded voltage waveform. In operation the TISP essentially shorts the generator output. The resulting loaded current waveform is specified.

electrical characteristics, $T_j = 25°C$

	PARAMETER	TEST CONDITIONS	TISP9180			TISP9290			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V_Z	Reference zener voltage	$I_Z = \pm 1$ mA	±145			±200			V
$^{\alpha}VZ$	Temperature coefficient of reference voltage			0.1			0.1		%/°C
$V_{(BO)}$	Breakover voltage	See Notes 5 and 6			±180			±290	V
$I_{(BO)}$	Breakover Current	See Note 5	±0.15		±0.6	±0.15		±0.6	A
V_{TM}	Peak on-state voltage	$I_T = \pm 5$A See Note 5 and 6		±2.2	±3		±1.9	±3	V
I_H	Holding current	See Note 5	±150			±150			mA
dv/dt	Critical rate of rise of off state voltage	See Note 7			±5			±5	kV/µs
I_D	Off-state leakage current	$V_D = \pm 50$ V			±10			±10	µA
C_{off}	Off-state capacitance	$V_D = 0$, f= 1 kHz See Note 4		110	200		110	200	pF

thermal characteristics

	PARAMETER	TISP9180			TISP9290			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
$R_{\theta JA}$	Junction-to-free air thermal resistance			62.5			62.5	°C/W

NOTES: 4. These capacitance measurements employ a three-terminal capacitance bridge incorporating a guard circuit.
5. These parameters must be measured using pulse techniques, $t_w = 100$ µs, duty cycle ≤2%.
6. These parameters are measured with voltage sensing contacts separate from the current carrying contacts located within 3.2 mm (0.125 inch) from the device body.
7. Linear rate of rise, maximum voltage limited to 80% V_Z (minimum).

PARAMETER MEASUREMENT INFORMATION

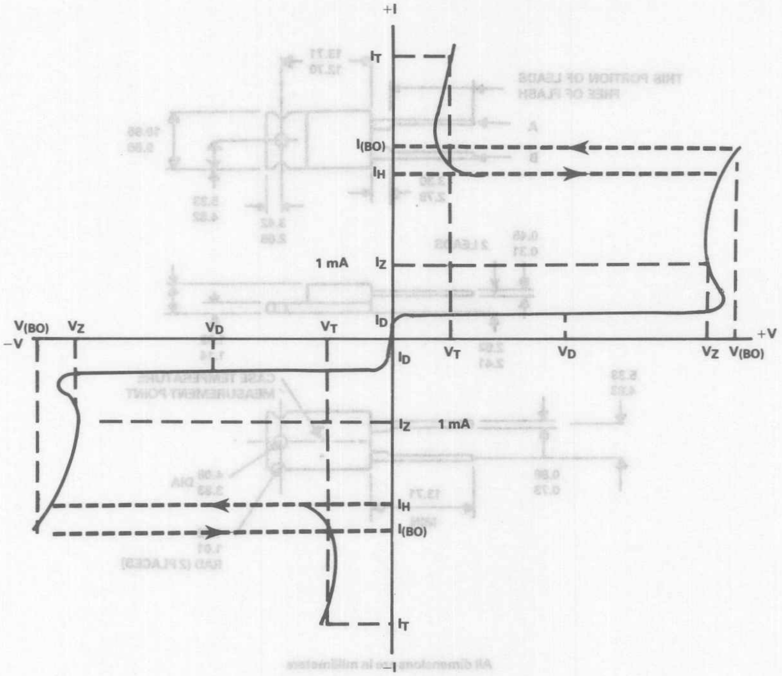
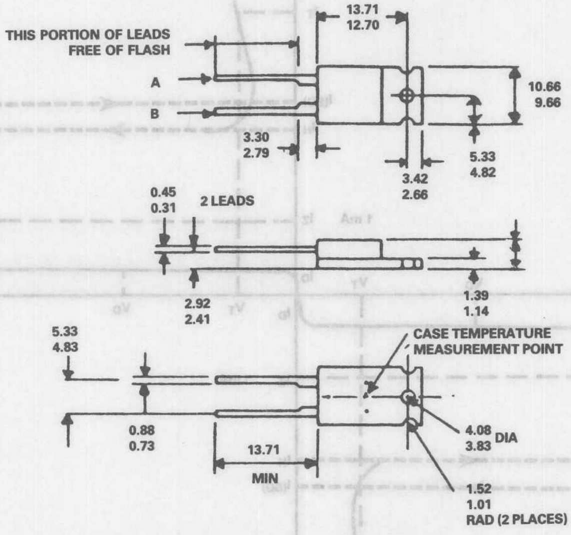


FIGURE 1. VOLTAGE-CURRENT CHARACTERISTICS FOR TERMINALS A AND B

mechanical data



All dimensions are in millimeters

General Information 1

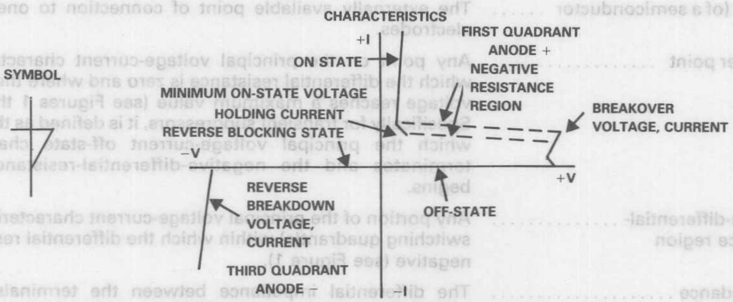
Transient Suppressors 2

Appendix A

Nomenclature

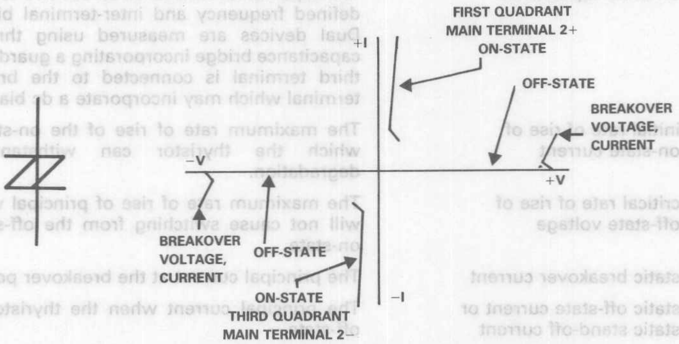
A terminal (T terminal, USA)	Device terminal normally connected to the A-wire of a telephone line. In the exchange the A-wire normally connects to the T(ip, USA) or battery + wire. Equivalent to main terminal 2.
asymmetrical	A condition when a two terminal thyristor has substantially different switching behaviour in the first and third quadrants of principal voltage-current characteristics. Normal qualifier for a transient suppressor which has a forward biased diode characteristic for positive voltages and crowbar characteristic for negative voltages (see Figure 3).
B terminal (R terminal, USA)	Device terminal normally connected to the B-wire of a telephone line. In the exchange the B-wire normally connects to the R(ing, USA) or battery - wire, equivalent to a second main terminal 2 in dual devices and main terminal 1 in single devices.
C terminal (G terminal, USA)	Common connection of a dual device, equivalent to main terminal 1. The C terminal is normally connected to the exchange earth/G(round).
crowbar	A bistable shunt device which switches from a high-resistance, low current off-state condition to a low resistance low voltage on-state condition when the applied voltage exceeds a specific value. Overvoltages are effectively ''shorted out''. The device is reset to an off-state by reducing the current below a certain value.
main terminals	The terminals through which the principal current flows.
main terminal 1 (of a bidirectional thyristor)	The main terminal which is named ''1'' by the device manufacturer. This is normally the reference terminal for all voltages.
main terminal 2 (of a bidirectional thyristor)	The main terminal which is named ''2'' by the device manufacturer.
terminal (of a semiconductor device)	The externally available point of connection to one or more electrodes.
breakover point	Any point on the principal voltage-current characteristic for which the differential resistance is zero and where the principal voltage reaches a maximum value (see Figures 1 through 3). Specifically for transient suppressors, it is defined as the point at which the principal voltage-current off-state characteristic terminates and the negative-differential-resistance region begins.
negative-differential-resistance region	Any portion of the principal voltage-current characteristic in the switching quadrant(s) within which the differential resistance is negative (see Figure 1).
off-impedance	The differential impedance between the terminals through which the principal current flows when the thyristor is in the off-state at a stated operating point.
off-state	The condition of the thyristor corresponding to the high-resistance, low-current portion of the principal voltage-current characteristic between the origin and the breakover point(s) in the switching quadrant(s).

on-impedance	The differential impedance between the terminals through which the principal current flows when the thyristor is in the on-state at a stated operating point.
on-state	The condition of the thyristor corresponding to the low-resistance, low-voltage portion of the principal voltage-current characteristic in the switching quadrant(s).
principal voltage	The voltage between the main terminals. NOTES: 1. In the case of reverse-blocking and reverse-conducting thyristors, the principal voltage is called positive when the anode potential is more positive than the cathode potential, and called negative when the anode potential is less positive than the cathode potential. 2. For bidirectional thyristors, the principal voltage is called positive when the potential of main terminal 2 is more positive than the potential of main terminal 1.
principal voltage-current characteristic (principal characteristic)	The function, usually represented graphically, relating the principal voltage to the principal current with gate current, where applicable, as a parameter.
symmetrical	A condition when a two terminal thyristor has substantially the same switching behaviour in the first and third quadrants of principal voltage-current characteristics (see Figure 2).
thyristor	A bistable semiconductor device that comprises of three or more junctions and can be switched from the off-state to on-state or vice versa (Ref., IEC 147-0) (see Figures 1 through 3).



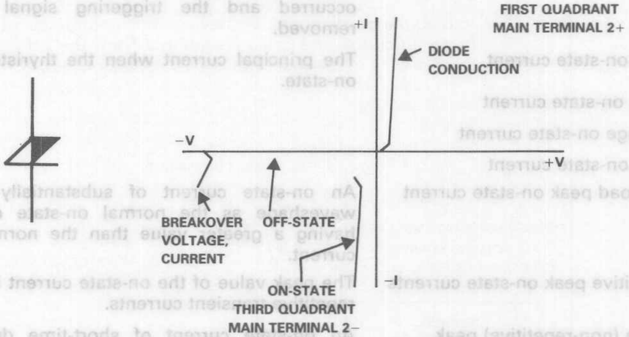
Principal voltage-current characteristics (anode-to-cathode voltage-current characteristic) of a typical reverse-blocking thyristor.

FIGURE 1



Principal voltage-current characteristic of a typical bidirectional thyristor.

FIGURE 2



Principal voltage-current characteristic of a typical forward-conducting thyristor.

FIGURE 3

Symbol	Term	Definition
C_{OFF}	off-state capacitance	The capacitance measured across two terminals at a defined frequency and inter-terminal bias voltage. Dual devices are measured using three-terminal capacitance bridge incorporating a guard circuit. The third terminal is connected to the bridge guard terminal which may incorporate a dc bias.
di/dt	initial rate of rise of on-state current	The maximum rate of rise of the on-state current which the thyristor can withstand without degradation.
dv/dt	critical rate of rise of off-state voltage	The maximum rate of rise of principal voltage that will not cause switching from the off-state to the on-state
$I_{(BO)}$	static breakover current	The principal current at the breakover point.
I_D	static off-state current or static stand-off current	The principal current when the thyristor is in the off-state.
I_F	forward (diode) current	The dc value used for the measurement of forward voltage.
I_H	static holding current	The minimum principal current required to maintain the thyristor in the on-state.
I_L	static latching current	The minimum principal current required to maintain the thyristor in the on-state immediately after switching from the off-state to the on-state has occurred and the triggering signal has been removed.
$I_{T(RMS)}$	RMS on-state current	The principal current when the thyristor is in the on-state.
I_T	static on-state current	
$I_{T(AV)}$	average on-state current	
I_{TM}	peak on-state current	
$I_{T(OV)}$	overload peak on-state current	An on-state current of substantially the same waveshape as the normal on-state current and having a greater value than the normal on-state current.
I_{TRM}	repetitive peak on-state currents	The peak value of the on-state current including all repetitive transient currents.
I_{TSM}	surge (non-repetitive) peak on-state current	An on-state current of short-time duration and specified waveshape.
I_{TSP}	surge (non-repetitive) peak pulse on-state current	A short duration on-state current having a waveform with an exponential rise and decay (eg 8/20 μs).
I_Z	static regulator current	The principal current in the off-state characteristic which is strongly dependent on the applied voltage.
T_A	free-air temperature (ambient temperature)	The air temperature measured below a device, in an environment of substantially uniform temperature, cooled only by natural air convection and not materially affected by reflective and radiant surfaces. (Ref MIL-S-19500D par. 20.20.1).

Symbol	Term	Definition
T_C	case temperature	The temperature measured at a specialised location on the case of a device. (Ref MIL-S-19500D par. 20.20.2)
T_J	virtual junction temperature (junction temperature)	A theoretical temperature based on a simplified representation of the thermal and electrical behaviour of the semi-conductor device. NOTE: This term (and its definition) is taken from IEC standards. It is particularly applicable to multi-junction semiconductors and is used in this publication to denote the temperature of the active semiconductor element when required in specifications and test methods. The term "junction temperature" is used interchangeably with the term "virtual junction temperature" in this publication.
T_{jmax}	maximum junction temperature	The maximum value of permissible junction temperature, due to self heating, which the thyristor can withstand without degradation.
T_{lead}	lead temperature	
T_{stg}	storage temperature	The temperature at which the device, without any power applied, is stored. (Ref MIL-S-19500 par. 20.20.3).
R_θ	thermal resistance	The temperature difference between two specified points or regions divided by the power dissipation under conditions of thermal equilibrium.
$R_{\theta JA}$	thermal resistance, junction-to-ambient	
$R_{\theta JC}$	thermal resistance, junction-to-case	
$R_{\theta CA}$	thermal resistance, case-to-ambient	
$V_{(BO)}$	static breakover voltage	The principal voltage at the breakover point.
V_D	static off-state voltage or static stand-off voltage	The principal voltage when the thyristor is in the off-state.
V_F	forward (diode) voltage	The dc voltage across a semiconductor diode associated with a forward current.
V_T	static on-state voltage	The principal voltage when the thyristor is in the on-state.
V_{TM}	peak on-state voltage	
V_Z	static regulator voltage	The principal voltage in the off-state characteristic at a specified value of regulator current (I_Z).
V_{ZM}	peak regulator voltage	The peak value of off-state regulator voltage occurring as the regulator current is increased from 0 to a specified value.

Symbol	Term	Definition
$Z_{\theta(t)}$	transient thermal impedance	The change of temperature difference between two specified points or regions at the end of a time interval divided by the step function change in power dissipation at the beginning of the same time interval causing the change of temperature difference.
$Z_{\theta JA(t)}$	transient thermal impedance, junction-to-ambient	
$Z_{\theta JC(t)}$	transient thermal impedance, junction-to-case	
α_{IH}	temperature coefficient of holding current	This is expressed as an average %/°C change over a given temperature range. It is calculated by dividing the difference between the upper and lower temperature values of holding current by the temperature change and the holding current at 25 °C.
$\alpha_{I(BO)}$	temperature coefficient of breakover current	This is expressed as an average %/°C change over a given temperature range. It is calculated by dividing the different between the upper and lower temperature values of breakover current by the temperature change and the breakover current at 25 °C
$\alpha_{V(BO)}$	temperature coefficient of breakover voltage	This is expressed as an average %/°C change over a given temperature range. It is calculated by dividing the difference between the upper and lower temperature values of breakover voltage by the temperature change and the breakover voltage at 25 °C.
α_{VZ}	temperature coefficient of regulator voltage	This is expressed as an average %/°C change over a given temperature range. It is calculated by dividing the difference between the upper and lower temperature values of regulator voltage by the temperature change and the regulator voltage at 25 °C.